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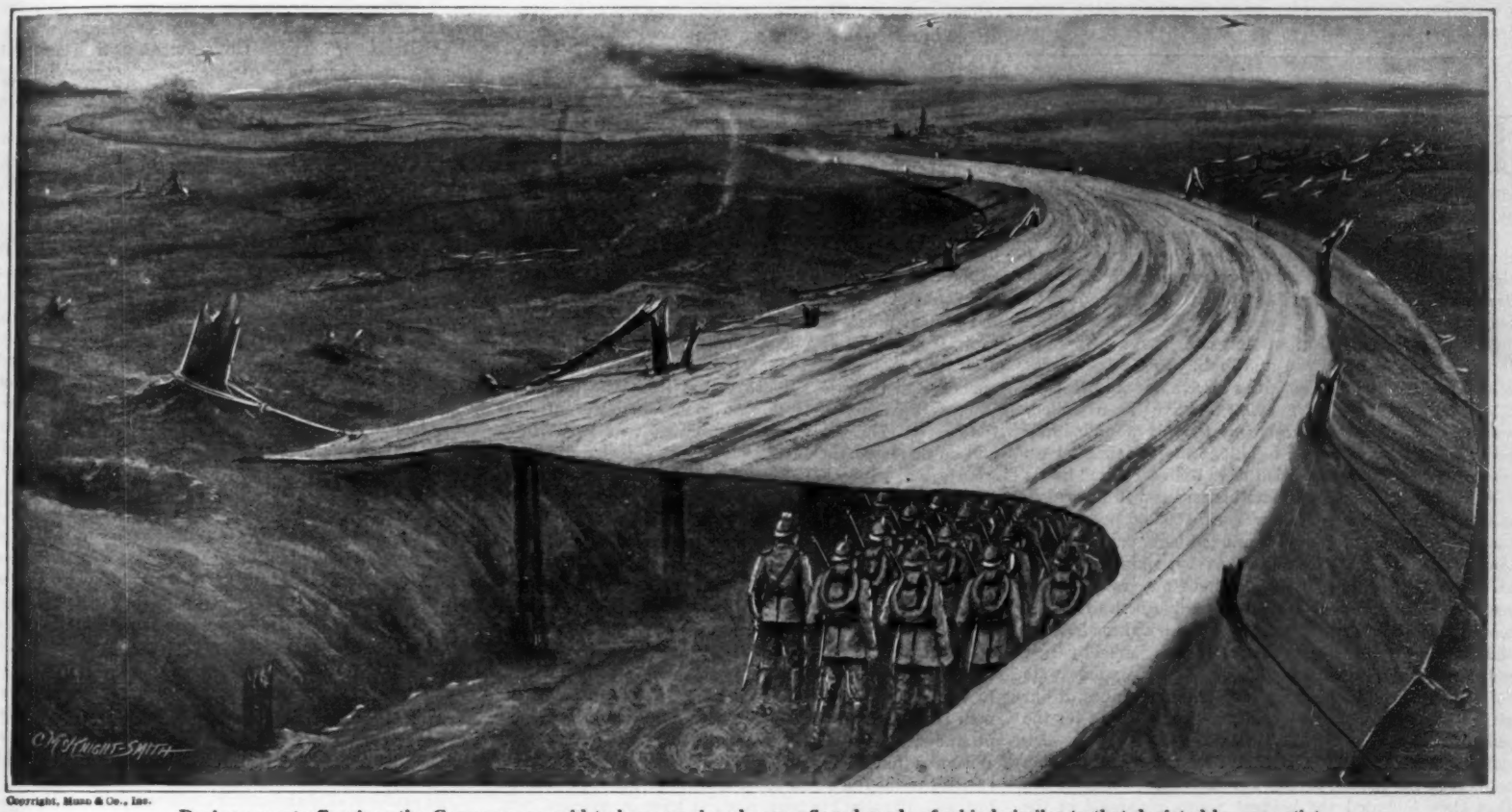

During recent offensives the Germans are said to have employed camouflaged roads of a kind similar to that depicted by our artist

Camouflaged Roads of the War

SURPRISE is still a predominant weapon of war, just as it has been in every war since the dawn of history. The most successful attacks in this war have been those prepared without the knowledge of the enemy, as witness the battle of the Masurian Lakes in the east when Hindenburg's German troops fell suddenly on the erstwhile victoriously advancing Russians and routed them completely, as well as the recent Von Hutier's strokes on the western front and Foch's counterblow against the Crown Prince's armies in the Marne salient. A dozen other examples of the strategic value of surprise could be cited, for proof is not missing in this connection.

One of the most interesting phases of surprise in modern military operations is the bringing up of large masses of troops and guns and supplies without the knowledge of the enemy. Von Hutier, as will be remembered from the article recently appearing in these columns, which dealt at length with the methods of that skilled German general, lays great stress on secrecy. He places his principal armies as far as 60 miles behind the front lines until the very eve of the battle, when they are brought up by forced marches at night. During the day the troops are concealed in villages and in woods; in fact, wherever ample covering can be found for the purpose. Enemy airmen, flying far into German-held land, discover no signs of extensive troop movements. When the battle opens the enemy, as was the case with the British during March and the French during May, are taken by surprise, not so much as regards the date set for the battle, but largely with respect to the numbers of troops involved.

Rumors have come back from France telling of the marvelous camouflaged roads employed by the Germans during their last ill-fated offensive in the Marne salient. These roads, it is said, are important, but not necessarily the main, arteries of travel for troops and supplies, and are covered over with mile after mile of canvas painted to represent the original road. Thus to an airman flying at thousands of feet altitude such as he must do in order to keep a respectable distance between himself and the enemy anti-aircraft guns, the camouflaged road appears absolutely deserted, while all the while thousands of troops, batteries of artillery, and supply camions may be moving along steadily toward the battlefront. The road can be readily camouflaged in this manner, albeit the amount of canvas required is considerable and the work of erection quite extensive. Still, the value of a camouflaged road cannot be overestimated, and it is obvious that no commander would hesitate to employ his camouflage corps in such a way.

It is said of the British camoufleurs that during the preparations for the great battle of the Somme, in 1916, they constructed a similar road. The occasional German airman over the British back areas perceived little activity on the ground. The most important road, to be sure, was deserted except for an occasional cart, a few soldiers and a fake gun or two. But all the while British Tommies were pouring to the battlefront, with their guns and supplies, under the camouflage canvas. So taut and so well supported was the canvas that it was possible to send light traffic along the camouflage canvas, thus leading the Germans to believe that the road was genuine, so the rumors go.

Camouflage appears to be without limit in this war. It does not seem unreasonable to look forward to the day when entire armies will move forward without a single man, gun, or supply truck in sight. They will make use of mile after mile of camouflaged roads; and when in the field they will march under woven grass carpets carefully painted to match the surrounding terrain.

A New Kind of Anchor Chain

A NEW kind of chain has been made successfully. It is the direct result of war needs and is known as cast-steel anchor chain.

Wrought iron chain, either hand or steam-hammer welded, has been used almost exclusively in ships to this day. It has always been such chain that has been attached to the anchors of all ships. Mild steel chain has been tried in the past, but it has so far proved either too ductile to retain its form under the severe stress or pull in use or too hard to insure reliable welds when the links have been welded or united together.

The old wrought iron chain is made and has always been made by bending round bars of various sizes of such iron into links and then welding them together and thus producing a chain of any desired length. They have always been satisfactory. So great, however, has been the demand for such anchor chain of all kinds and sizes in recent months because of the wonderful expansion in shipbuilding in this country that it was soon found that the wrought-iron chain-making capacity of the country was by no means equal to the demand. It is stated that now only one-third of the chain needed can be made by that process.

Steelmakers and foundrymen at once set about to solve the problem. The result has been that a method of pouring steel chain in molds has been devised and found to be practicable and successful. Chain of almost any size, suitable for anchors, can thus be made by pouring steel into sand molds. There are several ways that this can be, and is being, successfully done and chains as long as 90 feet are being made daily now and furnished the Government by one large company in particular. It is possible to pour the links all at once in one continuous chain or to pour separate links and then to put these separately in alternate molds and pour the other intervening links between and around these. So great has been the success of this new method that large orders have been placed and are being filled for this new type of chain, called cast-steel anchor chain.

A special kind of steel is used, but its composition is not revealed. It is an alloy steel, however, and is made only in the electric furnace since the quality for such a chain must be of the highest. Electric steel is the only grade of steel that can fill the bill. After being formed as chain, the chain is shaken out of the sand molds like any regular steel casting and then given special heat-treatment.

Thorough tests of such chain show it to be strong and of excellent durability and even better than the wrought-iron chain when it comes to withstanding shocks.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Great Britain Pays the Price

BY way of commemorating the anniversary of Great Britain's entrance into the war, the British War Commission has made public some figures which show how great has been the contribution of the Empire to the Allied cause.

The total enlistment throughout the Empire during the past four years has been 7,500,000 soldiers; and of these, 60 per cent, or 4,500,000 were raised in England itself; the proportion for England and Wales combined being 70 per cent.

The greatest contribution that can be made for any cause is that of one's life and limb. In the four years of the war the British casualties have amounted to over 2,500,000. Of these, over 500,000 have been killed, and at least an equal number so terribly wounded and broken that they will never be able to support themselves. So that over 1,000,000 British have been sacrificed in the four years of the war. What this means will be understood by those citizens of New York, 100,000 strong, who took part in the famous Sound Money parade some twenty years ago. The men went by, sixteen abreast, at a good swinging gait and without any considerable pauses; nevertheless it took over twelve hours for that host to pass the reviewing stand. Hence, if those 500,000 slain Britons could be called back and were joined by their still-alive but crippled compatriots, and the whole were to parade through the same streets and avenues of our city, it would take a week and a half of daylight for the sad procession to go by.

Furthermore, since the first four-and-a-half million soldiers of the British armies were volunteers, it is certain that they included the keenest young manhood of the Empire. From the universities alone at the outset of the war there went into service, we are told, some 8,000 undergraduates. Among these losses must be included practically all the officers and men of the small but highly efficient, Regular Army which Great Britain threw into Flanders at the outset of the war to engage the right wing of the German army.

That the mother country has led rather than followed the children of her Empire in sacrifice, is shown by the fact that one man out of every seven and a half of the population of England and of Scotland is in the army, one in every ten and a fifth in Wales; one in every twenty-six and a third in Ireland; and one in every fifteen in the overseas dominions.

Again, no surer test can be found of the service and sacrifice of a people than to compare the percentage of casualties suffered with the percentage of enlistment. On this basis we find that England and Wales provided 70 per cent of the enlistment and suffered 76 per cent of the casualties. Scotland's enlistment was 8 per cent of the total and her casualties 10 per cent. Ireland provided 6 per cent and her casualties were 6 per cent. The Dominions and Colonies provided 16 per cent of the Empire's forces and suffered 8 per cent of the total casualties.

In answer to the frequent question (which originated, by the way, in Hun propaganda) "Where are the British troops?" the War Commission replies that they are fighting on seventeen separate fronts scattered throughout the world. Outside of Belgium and France, British troops have been fighting in Italy, in Serbia, in Greece, in Russia, in North, East, and West Africa, and in China; while simultaneously they have carried on elaborate, extensive, and, because of climatic difficulties, extremely difficult campaigns in Palestine and Mesopotamia.

Of the debt of the whole alliance to the British Navy it is superfluous to speak. If Germany could have overthrown the British Navy, she would now be master of Europe, and her fleets and armies would be thundering at the gates of America. Under the protection of its fleet, the British merchant marine has transported 13,000,000 men, 2,000,000 horses and mules, 500,000 vehicles, 25,000,000 tons of explosives, 50,000,000 tons of oil and fuel and 130,000,000 tons of food and other stores.

War Labor Problems

THE entrance of the United States into the war brought the various Governmental departments face to face with most serious problems. Notably was this true of the Department of Labor. What these problems were was set forth with much force and clearness in an address by Secretary of Labor Wilson, as guest of honor at a luncheon in this city given by Grosvenor B. Clarkson, to the leading newspaper and magazine publishers and editors.

The magnitude of the field covered by the Department of Labor is shown by the total number, 35,000,000 men, women and children engaged in gainful occupations in this country. Of these, 13,000,000 are engaged in occupations that lend themselves to the formation of trade unions; and of this total, 3,000,000 are organized and about 10,000,000 are unorganized. Naturally the mobilization of labor for war work has to include both organized and unorganized labor.

The attitude of mind of labor to war when we were driven into it, was that our wars were capitalistic in their origin. The immediate problem of the Department of Labor was to change that attitude of mind—first, through the leaders of the trade union movement and then by direct appeal to the rank and file itself. To this end, the Department organized a propaganda of instruction and enlightenment, showing that we were driven into the war by the killing of our seamen; by the fact that the occupations of our men in our own factories and on our own soil would be destroyed by German agents; and by the intrigues of Germany with our neighbors to the south and to the west of us, so as to bring about dismemberment of our country. Furthermore, in answer to the theory of the propagandists that this was a war for the benefit of capital, it was shown that our entrance into the war destroyed, as a matter of fact, the unlimited profits which our capitalists were able to extort from the different Entente governments. For no sooner had we entered the contest than the President began to regulate prices, and an increased Income Tax and an Excess Profits Tax were levied. It was made clear to labor that, so far as the United States was concerned, the profits to capital were enormously reduced by our entrance into the war.

Another most serious problem confronting the Department of Labor was the propaganda of the Independent Wage Workers of the World, which was interfering seriously with production of material, particularly in the Middle West and Far West. The output of two absolutely essential war materials, namely copper and spruce, was being gravely menaced. The peculiar philosophy of the I. W. W. so far as it is based on the theory that every man is entitled to the full social value of what his labor produces, is that of the Marxian socialists. Secretary Wilson admitted, as we all must, that every man is entitled to the full social value of what his labor produces, but the difficulty has been that, at least in America, we have not evolved any method by which we can determine what the full social value of any man's labor is. In an earlier and simpler age the thing might have been done, for then the man who started to make any article usually completed it; whereas, under our modern industrial system, with its subdivision of labor, any estimate of the full social value of each man's work would be impossible. Now, the Independent Workers of the World do not believe, as the Socialists do, that the only way in which full social value can be obtained is through collective ownership and operation; they believe that the results should be obtained by direct action. The only reason property has value, they say, is because profits can be secured from that property; and if you wish to destroy the value of the property all you have to do is to destroy the profits; and the way to destroy the profits is to reduce production, either by sabotage, or by striking upon the job, or by any other effective method. When we have reduced the production to the proper point, profits will be eliminated, say the Independent Workers. The property will become valueless and the workers can then take over the property, operate it themselves, and get the full social value of what their labor produces.

That was the kind of philosophy the Department of Labor had to meet if it wished to keep the wheels of industry going. It was necessary to teach these men where they had made a fundamental mistake—to show them that though it was true that there could be no profits if there was nothing produced, it was equally true that if there were no profits there could also be no wages. They had to be shown that, although labor and capital have not an *identical* interest, they have a *mutual* interest in securing the largest possible production with a given amount of labor. As a matter of fact the fundamental reason why the American wage worker has lived better than his fellows anywhere else in the world is, according to Mr. Wilson, that he produces more than any other wage worker in the world, including the German workmen with their widely advertised efficiency.

And so the fact was brought home to American workingmen who had been subjected to this impractical I. W. W. philosophy that, if these people had driven the workers of the country to a policy of sabotage and striking on the job; and if they could have thereby reduced production to the point that existed before the age of machinery—the immediate result would have been a lowering of the standard of living of those men who are doing the actual physical labor. Even in the olden days, where every home was a workshop and work was done by hand, there were considerable profits for the employer, and the workmen were obliged to live on a very much lower scale of decency and comfort.

Federal Employment Bureau

IN the early wars of history it was possible for an army to support itself upon the country which it occupied; but under modern conditions, with the whole nation in arms, the forces in the field must be equipped and fed from home. When we entered the present great struggle Congress and the country joined hands in the work of mobilizing our industries so that they could support their enormous armies on the far distant front. Already we possessed a great force of skilled workers in our various industries, but with our war expansion, the call for skilled labor was multiplied.

Unfortunately, between Government institutions and private employers, both of which were engaged in war work, there developed keen rivalry in securing skilled workers. At the same time no provision was made for training the semi-skilled or unskilled worker, and many of the rumors that workmen were falling down on the job and slacking, were due to this neglect to train men for the work.

According to Secretary of Labor Wilson, before the war we had in the neighborhood of 12,000 to 15,000 skilled men engaged, to take an example, in shipbuilding operations; and within a few months after our entrance into the war we had increased the number who were doing work that required skill to several hundred thousand. This meant a great dilution of the men who were skilled mechanics; and consequently the average output of these several hundred thousand workers was very low. At present, the Government is furnishing intensive training to the semi-skilled and unskilled to raise the standard of efficiency in our shipbuilding and other yards.

The greatest evil, however, that has developed out of our labor war experience is the competition which has arisen among the private concerns engaged in munition production, shipbuilding, and other war work and those operating under Government control; for it is a fact that every one of the Government departments and every corporation engaged in the production of war material went out into the market resolved to obtain labor, no matter what the cost and no matter what disastrous effect it might have upon other war industries. The Government realized, at once, that there must be some method of standardizing wage rates, and some centralized governmental agency that could handle the supply of labor for all war industries.

The problem of standardizing wages might, at the first blush, seem to be merely a question of taking the highest wage rates that are to be found; bringing up all the wage rates in the country to that particular rate; and stabilizing and standardizing wages at that point. Unfortunately, such a method takes no account of the greatly varying cost of living in different sections of the country. This problem is now occupying the earnest attention of the Government.

In the matter of controlling the supply of labor, the United States Employment Service has taken hold of the problem with a firm hand. The employment of labor passes under Government control, so far as it applies to common labor in those industries employing 100 or more workmen. Those employing 100 or less will be allowed to go on securing their labor as best they can under their old methods. The new service, which covers the whole of the United States, will give daily reports of labor conditions to Washington, and it will be in a position to know where there is a surplus in any given line, and will be in a position to move the workers from the point where there is a surplus to the point where there is a shortage.

Nothing showed the necessity for a Bureau of Employment so clearly as did the enormous turnover of labor which obtained in various parts of the country. Prior to the war, it was nothing unusual to find establishments having a 200 to 300 per cent turnover annually—that is to say, the movement of men from one job to another was so great that it required the employment of 200 to 300 workmen to maintain an organization of 100. Secretary Wilson is authority for the statement that in some cases the turnover has gone up to 1,000 per cent; and in one particular instance, it went to 100 per cent a week for a period of some six or eight weeks.

It cannot be denied that the turnover of labor, the endless galloping of mechanics to and fro across the country, looking for the highest wage, is in reality an individualistic strike. Secretary Wilson states that his observation is that the individualistic strike—the turnover of labor—brings us greater loss than all of the collective strikes and lockouts that occur in the country. This is an amazing statement; but if any one should know the facts it is the Secretary of Labor. Evidently the institution of the United States Employment Service has come none too soon.

Electricity

Wirelessly-controlled Airplane.—From San Diego, Calif., comes a most interesting story of an airplane to be operated by wireless from the ground. The crewless aircraft is the invention of Flight Instructor Robbins of the Rockwell Field Aviation School. No details are available at present.

Powerful Wireless Station for Argentine.—It is announced that the Marconi Company will build the largest wireless station in the world near Buenos Aires. The contract for the work has just been closed. The power of the new station will be 11,000 kilowatts, and three towers will be erected, each the size of the Eiffel Tower.

Counting Coins by Electricity.—Much labor is saved daily at the offices of the Detroit street railways by automatic coin handling machines. A bank of machines handles an average of 200,000 coins each day. The machines are operated by one-third horse-power motors. The coins are placed in hoppers at the top, in all denominations, just as they come from the fare boxes on the cars. Without further attention, battered and badly worn pieces are thrown out and the remaining coins are sorted into their respective denominations. These are accurately counted and properly wrapped in rolls of any desired amounts. Thus a great deal of time is saved and the element of error is reduced to a minimum.

Boring Pole Holes with Gasoline Power.—The tiresome and time-consuming work of digging holes for telegraph and electric service poles is now at an end. At least, there has been evolved a gasoline driven earth-boring machine which makes an average boring time per hole of 1½ to 2 minutes. The equipment is mounted on a horse-drawn truck and is operated by two men. In ordinary soil it maintains an average of 100 holes per day, each measuring six feet deep by 24 inches in diameter. The equipment consists of a truck, which carries a gasoline engine, driving mechanism, and a huge auger which is slowly rotated and fed downward. The augers are furnished in sizes from two to twenty-four inches.

Five Minutes to Change Vehicle Batteries.—It requires about five minutes for the Edison Electric Illuminating Company of Boston to effect a change of batteries under ordinary conditions, according to *Electrical Review*. A demountable cradle is employed to hold the battery in the vehicle, and the work is done by means of an elevating hand truck and hydraulic lift. The truck is driven over the hydraulic lift so that the suspended battery is directly above. The hand truck is then rolled in and the hydraulic lift is raised until the battery compartment hooks disengage. The hydraulic lift is then lowered and the battery hauled away to the skids upon which it rests while charging. The reverse process takes place when placing a fully charged battery under the truck.

Producing Nitrogen from the Atmosphere.—The largest experimental plant in the United States for the manufacture of fixed nitrogen from the air, with the exception of the ones now being constructed for the War Department, is in successful operation at the United States Department of Agriculture Experiment Farm, Arlington, Va. At this plant, continues *Electrical Review*, the nitrogen from the air is combined with hydrogen to form ammonia which can be used in the manufacture of explosives and fertilizer. Experiments are now being conducted at this plant by the Bureau of Soils, with a view to increasing the efficiency of the process. The War Department is coöperating in this work. What is known as the Haber process of nitrogen fixation is being used. This process involves the production of ammonia from hydrogen and nitrogen. The two gases are mixed in the proper proportions, put under high pressure, subjected to intense heat and passed over spongy iron, whereupon a portion of the mixture combines to form ammonia.

Efficiency of Incandescent Lamps.—The criterion by which other lamps are judged at this time is the tungsten lamp, according to *Electrical Engineering*. In comparison, carbon and gem lamps are very inefficient. To produce a given quantity of light they require more electrical energy and a greater consumption of coal than do tungsten lamps. Stated otherwise, for a given consumption of watts and a given quantity of coal they produce too little light. While the relative efficiencies of these lamps are well known, it will serve in order to bring home the facts which are significant in this connection, to present the statistics once more.

	Carbon	Gem (Metalized Filament)	Tungsten
Watts	50	50	50
Candlepower (Mean horizontal)	16.8	20.8	48.8
Watts per candle	2.97	2.5	1.04
Corresponding lumens	174	207	476
Lumens per watt	3.48	4.14	9.52

In addition it is well known that the tungsten lamp is much brighter than the gem and carbon lamps. It is more fragile than the gem lamp, and much more fragile than the carbon lamp, the most rugged of all incandescent lamps.

Astronomy

The Carina Meteor Catalog, a record maintained at the Carina Observatory at Odder, Denmark, of meteors observed from stations in Denmark and surrounding countries, enumerates 6,554 meteors for the years 1875 to 1917, inclusive.

Nova Monocerotis.—When this nova was discovered by Wolf, at Heidelberg, February 4th, 1918, its magnitude was 8.5. Photographs made at Harvard furnish some details of its previous history. Its magnitude was 9.8 on December 22d, 1917, and 5.4 on January 1st, 1918. It has, therefore, pased its maximum when first observed visually. A detailed record of its diminution in brightness from February 23d to May 14th, as measured at the observatory of Lyons, is published in *L'Astronomie* for June. On the latter date its magnitude was 10.4.

Meteorological and Magnetic Observations During the Solar Eclipse.—A program of meteorlogical observations in connection with the total solar eclipse of June 8th, 1918, was carried out successfully by the Weather Bureau at numerous stations. At Goldendale, Wash., Prof. H. H. Kimball made use of a Smithsonian pyranometer, for measuring both the direct solar radiation and the diffuse sky-radiation throughout the eclipse; also a pyrgeometer, for measuring the intensity of the outgoing radiation from the earth. The shadow-bands were observed at several places. Magnetic observations were made by the Coast and Geodetic Survey at Green River, Wyo., Mena, Ark., and Orlando, Fla. The Carnegie Department of Terrestrial Magnetism made magnetic observations at several points, including one station, Corono, Colo., at an altitude of 12,000 feet. Measurements of atmospheric electricity were made at Lakin, Kans.

Photographic Observation of Variable Stars.—The work of observing variable stars has enlisted the services of a great number of devoted astronomers throughout the world, a majority of them being amateurs. The recently published eighth report of the variable star section of the British Astronomical Association, an octavo of 352 pages, records no less than 16,217 observations mostly taken during the period 1910-14, by 34 observers. Some of these persons made upwards of 2,500 observations. In his introduction to the volume, Prof. H. H. Turner raises the question whether these laborious visual observations are not destined to be replaced by photography, which has done so much for other branches of astronomy. There is at present one special difficulty—most of the variables are red or reddish in color, and it takes a long time to photograph them, or a large telescope, or both. Professor Turner mentions a photograph made at Oxford of the region of the very red variable S. Cephei, with exposure long enough to get the faint comparison stars, so as to determine their places. There was not a trace of the variable itself on the plate, though the star was then near its maximum. Great improvements have, however, been made recently in the photography of red light, and more may follow, so we need not assume that the present difficulty will be permanent.

Who Discovered Nova Aquilae?—The brilliant Nova which recently flashed out in the constellation Aquila was independently "discovered" by a large number of persons, and there has been considerable discussion centered about the rather academic question of who saw it first. W. F. Denning reports in *Nature* of June 27th that it was observed by Captain E. V. Piper, of Fowey, Cornwall, shortly after midnight of June 7th-8th. In the June number of *L'Astronomie* are published reports of several other early observations, of which the one least deserving of doubt is that of Prof. S. Laskowski, an anatomist and amateur astronomer of Geneva, who observed the Nova at 9.45 P. M., June 7th. It was then somewhat less brilliant than Vega. M. Quenisset of the Flammarion Observatory, Juvisy, has examined a series of photographs of this region extending back 30 years, and finds a star of the tenth or eleventh magnitude in the exact location of the Nova, on a plate taken by him July 7th, 1905. On searching the Harvard plates for the new star's early history, it was found to have been first photographed there on May 22d, 1888, when it was of eleventh magnitude; and several hundred plates of it are now being examined to study its variations, which amount to at least half a magnitude. On June 3d last it was of about normal magnitude; June 4th, 5th and 6th were cloudy; on June 7th it was of sixth magnitude. In other words, like most novae, this star is an old one which merely increased suddenly in brightness in a few days—from below tenth magnitude to the first. The Harvard plates throw the gravest doubt upon such reports as that of M. Joseph du Doré, of Montrevault, France, who asserts that the star was visible May 27th, and on May 30th was already brighter than Alpha Herculis. It appears that the first date on which the star could have been really recognized as something out of the ordinary was June 8th, the date of the last solar eclipse, and the one on which most of its "discoverers first saw it."

Automobile

French Automobile Merger.—There is considerable talk in automobile circles about a new move which is now in progress. One or several factories of very large size are to be organized during the war, the object being to put on the market after the war a car which will be sold at price much below that of the 1914 car. In this connection the Renault, Panhard, Citroen and Berliet firms are named, but nothing can be stated with certainty, except that the Berliet company of Lyons has now been reorganized at a capital of $10,000,000 with the object of building standard types of car on a large scale. These will be much improved over former types and will sell at a low price, and will therefore be generally purchased by the masses.

Guide Signs.—In the various proposals for developing motor transportation over our highways nothing has been said about guide posts, but that they are necessary is fully demonstrated by the frequent reports that have appeared of fleets of government trucks losing their way, especially at night. Considerable good work in this direction has been done, largely through private enterprise; but there is still a great deal to do in distinctly marking every fork and turn on all main routes, particularly through towns. And in this connection, it would be well to put on the statute books stringent laws to repress the rural hoodlum with a cheap gun or pistol who delights to use road signs as a target, to the great annoyance of travelers to whom guide signs in unfamiliar territory are an absolute essential.

Should the Car Fit the Man?—A tall man in a small car is a painful and uncomfortable spectacle, and while a short man in a big car may not attract so much attention, he is equally ill at ease. This suggests the nice problem of how to fit the car to the man. Of course the opposite is theoretically possible, and the tall man should get a car of suitable dimensions; but we cannot always afford the car we would like to have. Extension pedals have been offered the public; also adjustable steering columns, but the distance between the seat and the dash is really the controlling element that is difficult to adjust, unless, perhaps, an adjustable seat is provided for the driver. It would seem that a car provided with all three adjustments would prove to be a decidedly popular improvement, especially with men who represent the extremes of stature.

National Automobile Laws Necessary.—Long distance transportation has already demonstrated its utility and may be regarded as a permanent feature of the nation's business; but to promote its efficiency, and encourage its expansion it should be freed from the hampering restrictions of a multitude of traffic regulations, which vary with almost every State and town traversed. The whole question should be made a matter of national supervision, with, as far as possible, one set of regulations for the entire country, so that every driver may know clearly how to operate his car, no matter where he is. In no other way can costly delays be avoided. Where unusual conditions require special regulations, these should be approved by some central authority, and suitable notices displayed prominently at proper locations.

Taxes on Automobiles.—The proposal to tax automobiles according to their original cost appears to be a most illogical proceeding for there are thousands of second-hand cars for which their present owners paid but a small fraction of the new price. According to the proposed law many of these cars would be required to pay an annual tax equal to their purchase price, with the result that their owners would be compelled to abandon them, a matter of distinct injustice, and a great injury to the business interests of the country, as many of these cars are used for purely business purposes. A tax graduated steeply on a horse-power basis would seem much fairer to everyone concerned, and it would have the very desirable advantage of tending to legislate out of existance excessively large engines, which simply waste fuel to no good purpose. It would be a conservation measure as well as a revenue producer.

Through Main Roads.—England is also debating roads for motor transportation, for, although she is amply equipped with railroads, it is believed that hereafter motor trucks will play a prominent part in the business of the country. Systems of special highways are being mapped out, and the plans proposed include an apparently excellent feature. To avoid the delays and congestion incident on traversing towns, it is suggested that the main road be located beyond the borders of the town, and this would certainly expedite traffic, as it would not be necessary for every vehicle using the route to painfully thread its way through every village on the way. Of course this would not appeal to the local tradesman who hopes to catch an occasional penny from the passing cars, nor to the local magistrate who inflates his own income, and the funds of his town, by his interpretation of the law; but this is a matter of national interest and not to be restricted by petty local considerations.

Via Motor Truck

The Story of a Successful Motor Truck Transportation System

Fleet of motor trucks on the highway between established terminals, carrying freight shipments with the efficiency and dispatch of the peace-time railroad

THIS is a story of freight shipments via motor truck; of a man who devoted years to the study of the motor truck, spending thousands of dollars in acquiring bitter but invaluable experience, and who capitalized his wonderful collection of "don'ts" in a really big and startling way; and of a motor truck company which is now operating a freight service over highways between Washington, Baltimore, Philadelphia, New York and other cities with the efficiency and dispatch of a railroad. It is a wartime story; and it points out the way to motor truck freight service as a relief for the over-burdened railways.

The Man With the Big Idea

Ask the average man how to start a motor truck service and he will suggest the purchase of so many good motor trucks, hiring as many good drivers, and then handling the volume of business which is bound to follow. Simple, to be sure; but in practice it is by no means so simple. For if it were there would be more motor truck transport systems in operation. There is a vast difference between operating motor trucks for one's private use, and operating them as public carriers.

For years Mr. Perry E. Beam was engaged in the public motor truck business out on the Pacific coast. By degrees he mastered the intricacies of this most interesting of commercial undertakings. His fleet of trucks was constantly loaded and on the move, but he soon found out that filled motor trucks did not always spell big profits. There are so many ways to lose money in such service that he had to learn how to stop one "leak" after another, until he considered himself well conversant with the business. Thanks to his ability and patience, he finally captured the secret of successful motor trucking.

About two years ago Mr. Beam, then a resident of Portland, Ore., decided that the Pacific coast did not present a sufficiently broad territory for his vast motor truck plans. So he studied the situation in the East, casting about for a suitable central point or hub, so to speak, from which to develop truck routes in all directions. The first choice was of course New York. But for several reasons, among them the labor situation, the condition of the roads north and northeast of New York during the winter months, and the fact that he wished to include Baltimore and Washington in his operations, which would mean placing his hub at the end of the line and disarranging the ideal radial arrangement, he looked further. Finally his choice rested on Philadelphia; that city became the hub of his proposed truck service.

The company was organized in December, 1916, with a capitalization of $25,000 and with a single five-ton motor truck for equipment. On July 1st of the following year, the company was operating 22 5-ton trucks. On August 1st the daily express service to New York was inaugurated, and although the business was not extra promising during the months which immediately followed—most of the through trucks carried only part loads—the attention of shippers was riveted on the flawless performance day in and day out. Then business began to pour in until every truck between the two cities was loaded to the guards. In December, 1917, the company was forced to rent a six-story building in New York city for the receiving and transferring and storage of shipments.

One of the New York to Philadelphia motor trucks leaving the main garage at the latter city

From that time onward the story of the organization's growth speeds up to a dizzy gait. In the following February the company opened an office in Baltimore; and headquarters in Reading, Easton, Allentown and Bethlehem soon came along. Shipments are transferred at Philadelphia for Camden, N. J., Chester, Pa., Eddystone, Pa., Frankford Arsenal, Schuykill Arsenal, Hog Island Ship Yard, League Island Navy Yard, and Wilmington. At New York they are transferred for Brooklyn, Hoboken, N. J., Jersey City, N. J., and Newark, N. J., as well as to points in Connecticut, Massachusetts and Rhode Island. At Baltimore the shipments for Washington are transferred. At the time of writing the company operates, to full capacity, 57 5-ton motor trucks and a number of smaller, local-delivery trucks.

Freight Cars on Rubber-Tired Wheels

The rolling stock of the highway freight system is somewhat diversified. The first units were trucks with skeleton tops and tarpaulin covers; but as the system became more developed and new trucks were bought, the closed-in wooden bodies, strongly suggestive of a railroad freight car, were adopted. In fact, the present trucks employed on the long-distance service are provided with doors which are closed and sealed at the start of the journey so that there is no danger of damage or theft during transit. For short hauls, such as the distribution from receiving station to consignee in the case of small shipments, smaller trucks, generally of two-ton capacity, are employed. These have open bodies and are provided with tarpaulins. All the motor trucks are of the same make, which greatly simplifies the mechanical end of the organization.

One would naturally expect considerable trouble in the maintenance of the motor trucks, considering the gruelling service to which they are subjected. But Mr. Beam assures us that day after day the large and small motor trucks operate with a minimum of attention. Obviously, this is largely due to the elaborate system of inspection and repair employed by the organization, although no little credit is due to the perfection of present-day motor

(Concluaed on page 138)

Farmers bringing their egg shipments to the "belt line" motor truck bound for New York city

Loading small shipments on one of the large long-distance motor trucks

Motor Trucks in the War

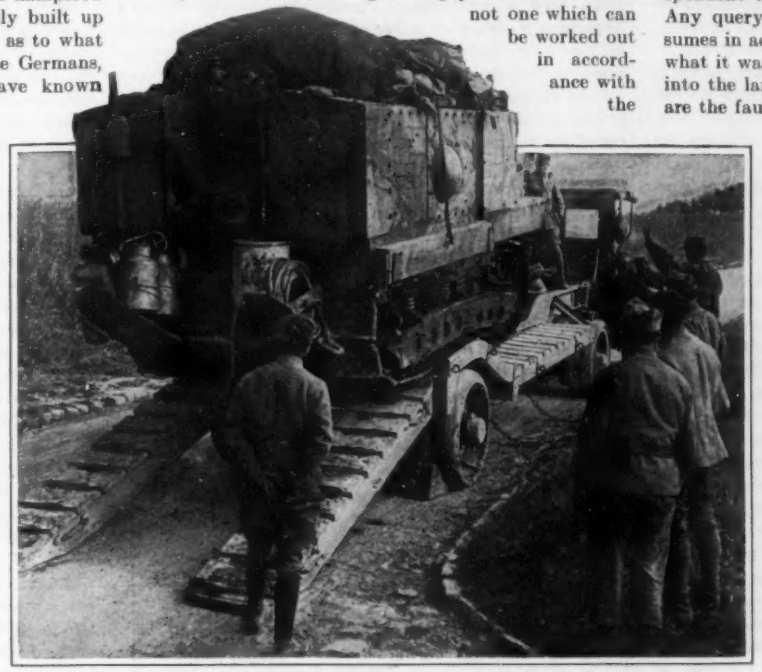
The Replacement of Wheel by Traction Belt Which Constitutes the Trend of Events over Four Years of Conflict

ALL the warring nations have made miscalculations in preparing motor truck service for military purposes. All are correcting their errors as fast as the newly gained insight dictates and industrial conditions make possible. Effective reasoning has been hampered by the strong and persistent ideas previously built up around the term motor truck, and by doubt as to what the conditions of war service would be. The Germans, who as the pacemakers should certainly have known better, were stopped at the Marne in 1914 not only by lack of munitions, but by lack of motor truck transport. The unprecedented construction of ammunition of the heaviest sort upset calculations as to the number of trucks needed. Subsequently winter weather, stout resistance and destruction of the roads showed the whole motor vehicle equipment to be deficient, not alone in numbers but equally in design. It did not support aggressive onslaughts adequately for more than three or four days at a time. Then the gigantic delivery service involved became demoralized by the lengthening of lines and the ravaging of the roads and the terrain over which the vehicles had to pass. Hence the war in fits and gasps which we have witnessed, with long intervals of relative inaction.

Undervaluation of the amount and severity of the required transportation service has been one of the greatest factors in shaping the course of events, being hardly secondary to that of human exhaustion. On the German side it was found impossible to contend with the enormous difficulties in allotting new supplies in the measure required at each point of the fronts as extended after aggressive action. The Allies tried to meet the problem with endless accumulations of the needed materials—that is, as soon as the industrial machinery became equal to such a task. But it is known that sooner or later, when continuous advance by the Allied armies takes place, the demands upon their motor trucks will far exceed those heretofore experienced. Interest in further improvement of the motor truck in the war is, therefore, intense, and entirely different in nature from that which has always been manifested in the gradual improvement of commercial motor trucks. It would be pedantic not to recognize this before the war is over.

Distinguishing lines between motor trucks and other motor vehicles are almost wiped out as insignificant when one inquires about transportation for the purposes of this war, how it is accomplished, what types of vehicle have been found most suitable. The determining factor in ordinary truck design is the load; but in war transportation it is the ever changing nature of the ground to be negotiated. Ton-mile economy counts for nothing; payload percentage of gross weight becomes a hollow civilian phrase acting as an impediment against efficient military reasoning. The problem is to supply food or ammunition or men at the rate at which they are used up, and often through a curtain of shell fire or through the dead of darkest night. Nothing counts but results.

The military motor truck, when reduced to its lowest terms, is a mechanical engineering problem. But it is not one which can be worked out in accordance with the notions developed in time of peace. Those who still insist on regarding it in that light must wait until a complete and painstaking history of the war is written before they will be enabled to separate and classify the tangled mass of information on detail truck mechanics that has been accumulated in the hands of military authorities. At present this mass is far from complete. Only fragments, which may or may not be important, have seeped into the channels of public information—fragments subjected beforehand to the catch-word interpretation of the average war correspondent and to the misgivings of numerous censors. Any query from the viewpoint of technical details assumes in advance that the war truck remains essentially what it was supposed four years ago to be. Translated into the language of realities such query means, "What are the faults and virtues for war work of various types of peace truck?" In this form it is interesting, but data for answering it are not given out. It was too great interest in these things that obscured the vision of the essentials in war trucks in the first place.



Small type of French tank, the "Baby Tank," being loaded on a motor truck trailer

It is only far behind the lines that a notable share of transportation of loads of three tons or more is done satisfactorily by motor trucks intended for such loads. The tremendous importance of having motor trucks in large numbers to help the railroads carry supplies to the bases of further distribution is, of course, admitted by all. But the truck that does specific war work is the truck that goes through. If its load has to be shifted to another vehicle before reaching the destination, it is the other vehicle in which our greatest interest lies. It may be a smaller vehicle, in default of a big one that can get through. But if it can be big enough to carry large loads, equal to the loads of peace trucks for peace conditions, and can yet get through, then that vehicle is the war truck *par excellence*. It can be assumed that no real technical values are thrown aside as worthless in its building, for never has experience been piled up so cruelly and convincingly as at the war fronts during the past four years. There is much evidence that this real war truck is now being turned out at top speed in Europe. At the same time this country relieves the situation by insuring a mammoth production of the more conventional trucks. These are certain to serve as well as the great majority of those used heretofore; in fact, by virtue of their great number and uniformity, they will do even a little better. The demands on their loading space and load-weight capacity will be reduced for emergency work over bad ground, while the standardization of their design and equipment will facilitate repairs and regular operation.

No secrecy is observed with regard to the outstanding characteristic feature of the war trucks, the feature on whose superior merits the military authorities have come to agree and which they are striving to get manufactured on a large scale. It is now considered

(*Concluded on page 139*)

Some proofs which bear out the often heard statement that our Army is to be the best motorized one of all

At the left: Unloading a seven-inch American howitzer from a special motor truck, by means of skids. *Center:* A light ordnance tractor with its armor elaborately camouflaged. Tractors of this type move at a fair rate of speed, and it is expected that they will be used in hauling light guns. *At the right:* Seven-inch howitzer in place on a ten-ton ordnance truck, with skids raised

Strategic Moves of the War, August 7th, 1918

By Our Military Expert

THE great offensive of the French in the Marne salient began on July 18th, and as usual, in all such moves, it had in the beginning the element of surprise. For five days previously the Germans had attacked in force in an endeavor to break the French front on the Marne and in the Champagne region. The blows had been successfully parried by most skilful tactical maneuvers on the part of the French commanders and the offensive at once passed to the Allies on the Aisne-Marne front. As soon as the drive was begun by General Foch upon the German right flank of the salient, the German commander accepted the inevitable and began his retreat, at first slowly and, after a few days, in earnest. The complete failure of his fifth offensive and the bitter defeat of his armies inside the Marne salient could no longer be hidden from the German people.

Had he been governed only by military considerations, he would not have held on so long in the dangerous angle of the Marne front; but, as happens so often in similar cases, political considerations had to be taken into account. The latter explain his wavering strategy for the first few days; but, when military requirements gained the day, it must be said that the withdrawal from the "pocket" in which his troops had been placed was most skilfully managed despite the loss of men and immense quantities of material.

The first problem to avoid possible disaster was to prevent the surrounding and capture of the German armies caught in the salient. To do this, a new German reserve army was called in and placed on the hills north and east of Soissons. The divisions before Rheims were strongly reinforced and artillery in mass was assembled at the corners, both at Rheims and at Soissons. By these means, the pocket in which his armies were caught was kept open and a retirement made possible.

But a second problem was presented in the difficulties of removing the immense concentration of guns, materials and supplies that had been collected for the offensive movement. After having secured the flanks at Soissons and Rheims, a week was consumed in withdrawing these concentrations; this was managed by holding back as much as possible the attacks of the Allies on the three sides of the salient, which was done by most vigorous resistance to the constant forward thrusts of his opponents day and night. The advance of the Allies was therefore very slow at first, and it was only on July 28th that the north bank of the Marne was fully cleared of German troops. Afterwards, the withdrawal was conducted more rapidly, first from the Marne salient proper, and then from the Marne to the Ourcq.

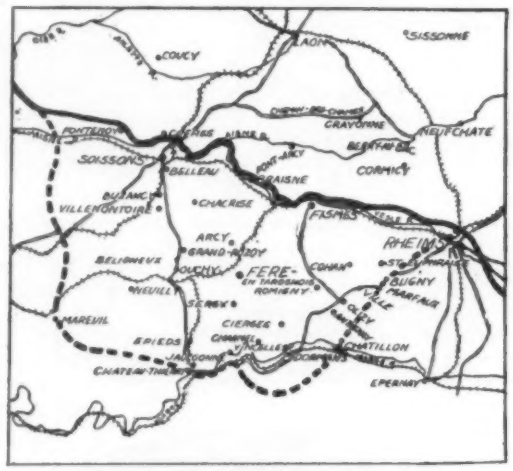
It remained to be seen whether the area between the Ourcq and the Vesle could be held or whether it would be necessary to withdraw between the Vesle and the Aisne. The German commanders had been freely publishing the fact that new lines had been established in the upper portion of the Aisne-Marne salient, which would be stable and permanent. These statements were based apparently on the very insecure belief that the initiative would be dropped by the French and that the counter-offensive would die out. But that has not proved to be the case at all, for the constant attacks combined with the pinching operations show that the French commander has had no intention of quitting. On the contrary, the forward thrusts are proving how far from stable are any German lines so far encountered in the salient. The new lines referred to are constantly being broken, almost before they have been established and everything points to still further penetration.

The advance of the Allies along the western side of the salient is especially important because of the fact that the positions gained by them now command the entire country to the north and really take in flank and in rear the whole western exit through which the Germans have been retiring, although the arc is thickly studded with German machine guns and German reserves. The capture of the heights on the westerly side of the line, especially of the watershed between the Ourcq and the Aisne, means that the Germans must hasten their retreat and must certainly withdraw beyond the Vesle and possibly the Aisne. General Foch is in fact driving a wedge in the sector, near Soissons, that has compelled the Germans to go back behind the Aisne river from Soissons to the junction with the Vesle. Since that has taken place, the Germans to the east had to take prompt refuge behind the Vesle or be pocketed in the salient. It is evident that the German retreat has not ended and that it has not yet reached what is considered as a proper tactical objective and as a truly secure defensive base.

Where this will finally be, will be determined no doubt by circumstances as they arise; but, with the present forces at their command, there is little danger of any move to the rear that will border upon actual rout. As far as can be learned, there were seventy divisions in the German forces in the salient or approximately seven hundred and fifty thousand men. Of these forces it is estimated the Germans have lost at least two hundred thousand men, five hundred guns, and a quantity of war material that is enormous. Up to the present the Germans have already drawn back on the average about fifteen miles on a front of fifty and have therefore given up half as much ground as was surrendered by Hindenburg in the spring of 1917.

Originally the German commander had opened up the valleys of the Oise and the Marne for a great drive upon Paris; but, by his counter stroke, General Foch had gained control of the Marne Valley and had effectually dammed it against any further German advance, unless some new success like that on the Amiens front in March could be gained. On this point there have been a good many surmises as to the enemy's beginning a strong offensive at some other place in order to lessen the danger to his retreating forces as they go back to the Aisne. If the Germans can muster a force strong enough for such a venture, it would be good policy to start such a move as early as possible; but certainly the morale at least of the German army at present, aside from lack of sufficient troops, would hardly be conducive to such an attempt.

The Germans at present have been forced back to the line of the Aisne and Vesle; but there is little probability they can hold these for any length of time. Between the two rivers the country is almost a plateau with few elevations and with no such forests and hills as extend from the Vesle to the Marne, through which the Allies have so far successfully fought their way. The country now in their rear for some distance is open and the Germans will therefore have a hard time to make a strong resistance without very superior forces at hand. French and American troops have captured Fismes, the largest German storehouse on or near the Vesle; already



Battle line from Soissons to Rheims, showing ground recovered by Allies

some of their units are across the river at points to the east. Northwest of Rheims the French are extending their lines considerably outside the old battle fronts, with every indication of being able to strike the German left flank of the former salient—now merely a dent. With Soissons in their hands and with their present advantages on the German right flank, the Allies can readily continue their pursuit of the retreating foe, who can be in comparative safety only behind the Aisne. And even there the flank may be turned from the salient to the west of Soissons.

In fact, it would seem that the German commander must go back to the Chemin des Dames after his efforts in this second battle of the Marne, which, like the first, has had for the Teuton allies such a tragic end. He attempted to stand on his lines between the Ourcq and the Vesle, which resulted in failure. And since that time his retreat has been marked by demoralization and a rush for a safety zone. It is an odd coincidence, that, after four years of struggles with alternating successes and defeats, it should be again on the Marne and its vicinity that a German offensive should have failed and that the same flank maneuver made by Joffre and Manoury in 1914, should have been repeated by Foch in 1918 with the same good fortune.

The present German retreat from the Marne has been described as a well conducted military operation; this may be true, but there are many things that cannot be explained. Why was such a glaring error made, when the offensive was developing, of leaving the right wing exposed to a flank attack, knowing the skill and strategic ability of the French commander? When the blow fell, as it was sure to come, there was a wavering and lack of decision on the part of the German general staff that is unexplained. After the first shock, there was never any question of an envelopment of the German forces; for a wide open exit to the north was always available. But there was delay in going back, either for political or military reasons as before stated. Reserves were used up in defending positions of no great value; when forced to retreat, the movement to the rear has been made under circumstances that showed the scope and thoroughness of the defeat. And, now with the army across the Vesle, the Germans are showing every symptom of demoralization and disorder. It would seem that the Germans can be safe only on the heights of the Chemin des Dames when they will have close behind them the great supply depot of Laon, the support east and west of other armies and will themselves have lines of defence that were held by them for years.

Two German retirements have been recently made on the Somme front that indicate a spirit of caution very different from what took place in the advance in the Marne salient. On Friday, August 2d, the Germans retreated across the Ancre River northeast of Amiens on a six-mile front and on Saturday withdrew across the Avre River southeast of Amiens on a 10-mile front. They are therefore now engaged in three retirements, one forced and two voluntary—all three with a view to safety. In each case, they are going back with as much care as the circumstances allow—by alternate sections and with every preparation for searching cross-fires on advancing opponents.

The moves in the Somme sector may be the beginning of another strategic retreat to forestall a French-English advance that may have been planned here. It would seem that the German leaders, by withdrawing from exposed advanced positions, are preparing for a defensive on this front. It is possible that the Germans are expecting an Allied attack on one or both sides of the Somme salient where weak flanks offer to the Allies some of the same advantages gained by the crushing blow on the western flank of the Marne salient. There are two great facts that are governing the present movements of the Allies and may lead at once to renewed efforts. One is the recovery of the initiative by the high commands and the consequent improved morale of the troops under them; the other is the uninterrupted flow of reinforcements in such numbers as materially to increase the advantages on several fronts. These increases in numbers are largely due to the arrival of American troops.

When the recent attacks were made by the German commander, he did so with numbers at least equal, if not superior, to those of the Allies opposed to him; but he fully recognized that this superiority of strength could hold only for a short time and that it would quickly disappear. Such has now become the case; combined with the skill of a capable and daring strategist of the caliber of the French commander, there can in the end be but one result. On that account, it is well to keep in mind that the German commander is now directing his campaign with the main object of conserving his man power and of shortening his lines. The present withdrawal to the Aisne, the readjustment on the Avre, and the retirement on the Ancre, all point to the fact that the Germans are strengthening their defences by shortening their lines, thus making up for losses on the Marne and elsewhere.

It is likely that further withdrawals are in order to the south and east of Amiens and that considerable readjustments of the German lines in the salients to the north will be made. There can be but little question that shortage of men is the primary reason for recent moves by the Germans. It is estimated that, by the retreat from the Marne alone, the number of troops necessary to hold the lines has been economized to the extent of 10 divisions (125,000 men). The German retreat to and beyond the Aisne River continues slowly and the place of final stand has been nearly reached. The present situation is probably the turning point of the war; its effects are being daily shown by the depression and discouragement reported as existing in Germany. And these last are not mitigated by the puerile attempts of the military machine to explain away the disasters.

For the French, the situation about Soissons where their troops have crossed the Aisne and are pushing to the northeast is full of possibilities. The immediate purpose of this movement is no doubt to gain such a position in the enemy's flank and rear of the Aisne line as will force him to abandon a strong position without a pitched battle. The move may have even a more ambitious project for it may be an effort to push the Allied lines up to the Oise front, which would be a way of carrying out here what has happened in the Marne salient. By shifting the whole battle front to the left, an effort could be made to outflank the enemy now before Amiens. Heretofore, the French reserves have not been numerous enough to allow such an attempt; but to-day, with American aid, the situation has changed sufficiently to probably warrant the risk.

Postal Motor Trucks

How They Can Be Made to Pay for the Roads on Which They Will Run

By C. H. Claudy

NOT least among the strange developments which the United States is undergoing in these recent stormy years are those which have risen or are to rise from government activities in lines which have hitherto been held entirely in State hands or in the hands of private interests. *"C'est la guerre"* is a reason for anything in France—perhaps the mental awakening of this country in peace activities is also "because of the war." However that may be, it is as pleasant as it is strange to find the Federal Government proposing to take an active part in road construction, not because of any private economic need of good roads, but because it, the Federal Government, finds that by so doing it can make a handsome profit for itself and at the same time serve its people the better. It is as unusual as it is interesting to find the Federal Government making an exhaustive study of the cost of motor truck operation when such vehicles are used for the transportation of both mail and miscellaneous freight (parcel post) and it is as queer as it is unexpected to find constructive initiative cutting through red tape and producing results of farreaching economic value in a totally new development of highways, motor cars, mail transportation and food transportation.

All of which has to do with the revolutionary experiments conducted by the Post Office Department in the establishment and the successful operation of eight motor-truck parcel-post and mail routes, the statistical studies resulting therefrom, and the proposal to extend this evidently necessary and profitable service, first throughout the states east of the Mississippi, and later over the entire Federal domain.

The eight routes referred to are between Philadelphia and Atlantic City, between Baltimore and Solomon's Island, between the capital and Leonardtown, between Washington and Baltimore, between Baltimore and Lancaster, between Philadelphia and Washington, between Savannah and Statesboro and between Columbus and Zanesville.

For a moment and before digesting any dry-as-dust statistics, let the reader admit for the sake of argument that these routes have proved themselves very highly profitable. His next natural question is "if the government can operate parcel post automobiles with a very large margin of profit, why can't commercial firms do the same thing? And if the commercial firm can do it, why should the United States government jump into the commercial game and compete with existing methods of transportation, freight, express, rail, water?"

The answer is very simple. The United States and *only the United States* can carry first class mail. And there is no other commodity which pays such a price for its transportation. At three cents an ounce, first class mail brings in $960 per short ton. But first class mail actually brings a much higher rate, for the average letter on which three cents is paid weighs less than half an ounce. First class mail easily averages $2,000 a ton or a dollar a pound. Not only can no commercial firm carry mail but no commercial firm can carry any freight at such a price, because no one will pay that price for anything except mail.

In establishing any new system of transportation, it is necessary to gain the confidence of the people served, an operation which takes time. No motor truck route, government or private, is going to be a paying investment at the start. It must wait, and run, and run, and wait. The United States government can finance such a wait. But it doesn't have to because it begins to carry first-class mail from the date of establishment of such a route, which mail more than pays for the expenses without counting any profit to be made in money by the government, or in service by those who use the motor trucks to send market produce to sales centers.

Consider for a moment something of the financial end of such routes and what it figures in dollars and cents.

In the first five months of this year, the eight routes mentioned carried a total of $152,237.74 of mail—all classes. The total operating expenses were $27,130.98. The total profit was $125,069.26.

There was a loss of $860.52 on the Philadelphia-Atlantic City line. The other seven routes showed individual profits running from $255.83 (Savannah-Statesboro) to $35,764.21 (Washington-Leonardtown).

Naturally, statistics of profit are worthless unless there is a very clear statement of just what "operating expense" may be. The Post Office Department doesn't beg the question in the least. And the statistical study of actual operating cost is a matter of great interest, not only to the "folks back home" who may want to say a word to their representatives about the extensions of such a service to their own doors, but to owners and operators of commercial vehicles, who can surely find in this presumably unbiased examination a standard which they can set, or a mark at which they can shoot, to beat if possible.

Cost of operation is classified by the department under the following heads:

Gasoline, grease and oil, tires and tubes, repairs (labor and material), accessories, garage, salaries, supervision, interest, depreciation and miscellaneous. The study is further extended to total cost, total mileage, cost per mile and miles per gallon of gas.

For the period of six months, from December 1st, 1917, to May 3d, 1918, the eight routes mentioned consumed 21,636 gallons of gas at a cost of $5,325.64. Grease cost $823.89, tires and tubes $3,426.92, repair labor $1,388.82 and repair material $528.08. Accessories figured $116.45, garage $864.86, salaries $8,428.73, supervision $3,439.07, interest $323.11, depreciation $3,032.22 and miscellaneous $1,401.83.

This makes the total cost $29,099.63 for a total mileage of 201,811 and a total cost per mile of $.1442. The average miles per gallon of gas were 9.33.

It is now easily to be seen how these routes can operate at a great profit from small mail income. In the case of the Washington-Leonardtown run, for instance, which is about 75 miles, at 15.75 cents per mile (in this run the cost was above the average) the cost of a trip is but $11.82 and less than 25 pounds of first class mail will pay that sum at the full rate of three cents an ounce. As a matter of fact 12 pounds of first-class mail of average weight will pay the cost. And the capacity of the machine is many, many times 12 pounds—all the rest of the space and weight carrying ability can be devoted to parcel post at parcel post rates; eggs, fish, vegetables, chickens, anything—to be brought from a production to a consumption center in the only quick way now feasible between two centers!

The postoffice finds that the efficient and economical

(Concluded on page 136)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Why the Cow Crossed the Road

To the Editor of the SCIENTIFIC AMERICAN:

Why the cow crossed the road has been a standard conundrum for ages. From time immemorial this contrary beast and its companion in misfortune, the chicken, have crossed the road on the run at risk of life, liberty and the pursuit of happiness, both their own and of legions of provoked drivers. Why is this?

It is submitted that the answer lies in the fact that cows and some other animals, chickens and some other birds, have monocular single vision, as you have taught us to define it in the Dr. Bates controversy. In other words, each eye may be focussed on a different object without mental confusion.

When a cow faces an object, both eyes may with ease be focused on it. When the object is at the side or rear, one eye may be focused on it, while the other is viewing objects in quite a different direction. Evidently the animal may direct attention to one object with both eyes, or to two objects with different eyes, or it may inhibit one eye and direct and concentrate attention with the other toward some object of fear or fancy.

In advancing in a car toward cows standing in the roadway, it will be noticed that those facing the car usually turn to one side and let the car pass; those with side toward car will, if on, say, the right side of the road, run and attempt to cross to the left side; those with head away from the car will usually run down the roadway ahead, turning off at one side or the other.

The reason why the cow or chicken on the right side of the road turns to cross over to the left, and vice versa, is, I suggest, because the eye of the animal which sees and appreciates the danger of the advancing car is by instinct kept on the dangerous object. To turn to the right and escape would blind the animal during the period of turning, and this she will not willingly do. But if she runs across the road in front of the car, the eye with which she first observed it will keep it clearly and continuously in view and, she thinks, allow her to escape the impending danger. Even when safely across, if turned around, by encountering a fence or by chance, so as to perceive the enemy with the other eye, I have seen her run for dear life to recross the road to the side whence she is just come.

The instinctive action, originally protective, is thus made a source of danger to the animal. The chicken, with monocular vision, labors under the same hallucination; it, too, thinks that the danger may be avoided by running with all its might, keeping the enemy all the time in view with the eye that was originally turned toward it. Thus, truly, the cow crossed the road because she crossed the road.

H. L. WHITED.

Making Tin Plate in Australia

THE supplies of tin plate for Australasia, the value of which amounts to over $12,000,000 per year, are drawn from Great Britain and America; but recently the lack of shipping and other difficulties have led to a serious shortage in deliveries. A leading Australian producer of steel has accordingly arranged to establish tin-plate works which will eventually supply the whole of the Antipodal demand. Plenty of tin is available in Australia as well as the necessary steel. The company in question, in addition to supplying steel for Australia, has sent considerable quantities of munitions steel to Great Britain and has also opened up trade with South Africa by supplying 20,000,000 tons of steel rails.

The United States Employment Service

ON August 1st, the new arrangement went into effect, centralizing in the United States Employment Service of the Department of Labor the business of supplying with common labor all war industries having a payroll of more than one hundred men. With this date, all independent recruiting by manufacturers of labor in this class will cease. This is in accordance with the decision of the War Labor Policies Board, approved by the President June 17th.

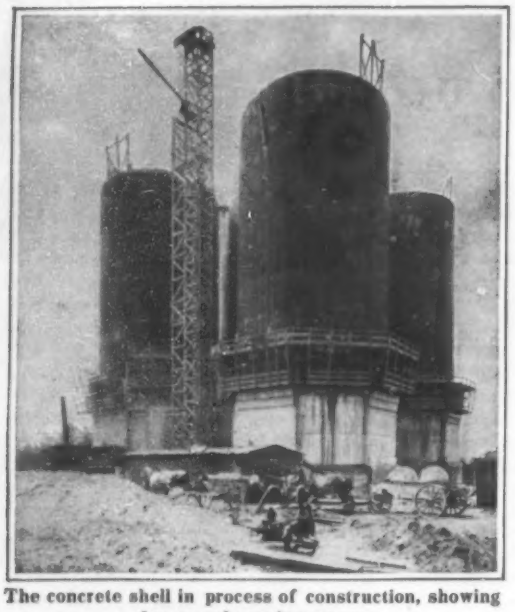
The necessity for some such step has long been developing. In no other way, apparently, was it possible to overcome a perilous shortage of unskilled labor in the war industries. This shortage was aggravated by an almost universal practice of labor stealing and poaching. It is on its face an impossible situation when in Pittsburgh, for example, there are advertisements calling for men to go to Detroit, while in Detroit street cars there are posters asking men to go to Pittsburgh. This same condition is apparent all over the country and in the consequent shifting of labor a great part of our war strength is dissipated. In some instances the labor turnover is as high as one hundred per cent a week, which is obviously ruinous.

While the restrictions against private employment of labor apply only to common labor at the present time, these restrictions will, as soon as possible, be extended to cover skilled labor also. In the meantime, recruiting of skilled labor for war production will be subject to Federal regulations now being prepared. Non-essential industries will of necessity be drawn upon to supply the labor required for war work; but the withdrawal will be conducted on the most equitable basis which can be devised, in order to afford the individual employer the maximum of protection.

A survey of labor requirements is being made; and in order that local interests may be protected, rulings have been made that no labor shall be transported out of any community without the approval of the State Director, nor from one state to another without the approval of the central bureau in Washington. All efforts will be made to discourage movements from community to community or from state to state by other services.

For the present, the new service does not apply to labor which is not directly or indirectly solicited; the man who wants to get out and hunt a new job for himself will be free to do so. It does not apply to labor for the railroads, or for farms, or for non-war work, or for establishments whose maximum force does not exceed one hundred men. Whether it will be extended to any of these classes will doubtless depend upon its success with the class for which it is designed, and the extent to which these unfederalized classes are found ultimately to conflict with the immediate needs of the big war industries. In any event, it seems probable that the recruiting of farm labor may be left where it is now, in the hands of the Department of Agriculture.

The general policy of the new service will be to keep any community from being drained of labor, and, so far as possible, to use local supply for local demands. The situation, however, is such that in certain cases men may have to be transported over distances.



The concrete shell in process of construction, showing forms and pouring stages

Concrete Shell for Unsightly Tanks

THE citizens as well as the engineers of Cincinnati, Ohio, were troubled at the prospect of disfiguring a beautiful residential section of the city with five 100-foot water tanks, and many plans were presented for making them less unsightly. The one chosen for architectural effect was a shell of concrete which transformed the huge ugly towers into impressive monuments. The problem of form work for the construction of the shell was difficult.

First the tanks were constructed in the usual manner, of steel, and these were filled with water so that they would be the same shape. It was feared that if concrete were poured while they were empty slight changes might take place when the tanks were filled, causing the concrete to crack.

The forms for the first section setting were placed on the foundation and braced to the ground. As each panel of the form weighs a ton it is readily seen that it was a difficult task to raise the huge weight. It was done by means of floats, a panel at a time. A lifting derrick, which can be seen in the illustration, is supported by a two-boom crab-operated rig resting on empty oil barrels on the water surface of each of the four corner tanks. Flotation is only used to shift this rig from one form to the next. In order to lift the ton-weight of the panel the float is blocked down in the Z-bar (which forms the top of each tank), at the rear end, while the forward part is hooked over the Z-bar. Then when the panel reaches the place where the work is to be done it is fastened to lugs riveted to the steel tanks.

The hoisting tower serves double purpose, one side is used as an elevator for the workmen while the other is for the concrete skip. This tower also has a boom for raising the reinforcing.

Even these water towers have been designed so that they fit into the City Beautiful plan of Cleveland. The top of the concrete structure has the appearance of the battlements of an old fort, and is really very effective.

Protecting Piles from the Teredo

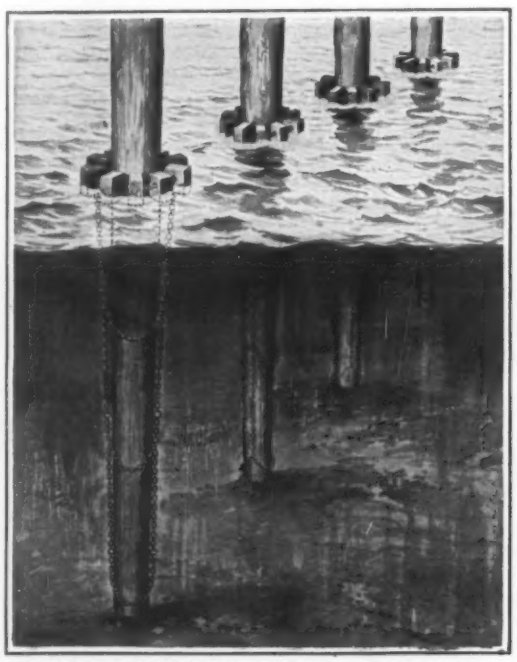
CHARLES F. LOCKWOOD of San Francisco, after observing the operations and characteristics of the teredo and lymnoria, which cause annually tremendous loss by the destruction of piling and other submerged waterfront property, has invented a device which has apparently demonstrated its efficacy in very much reducing if not eliminating the teredo evil in piling supplied with it.

Mr. Lockwood concluded from his observations that the teredo and other wood borers come in with the tides from the sea in the form of jelly or cloud, which floats on or near the surface of the water until it collects on rough surfaces, such as barnacles and other growth clinging to submerged wooden piling in salt water. This is indicated by the fact that wood piling near the entrance of bays or inlets is the first to be destroyed by these mollusks. His theory then was to prevent the collection of the destructive element at the start upon the surfaces of the piles, keeping the pile smooth and free from barnacles and marine growth of all kinds.

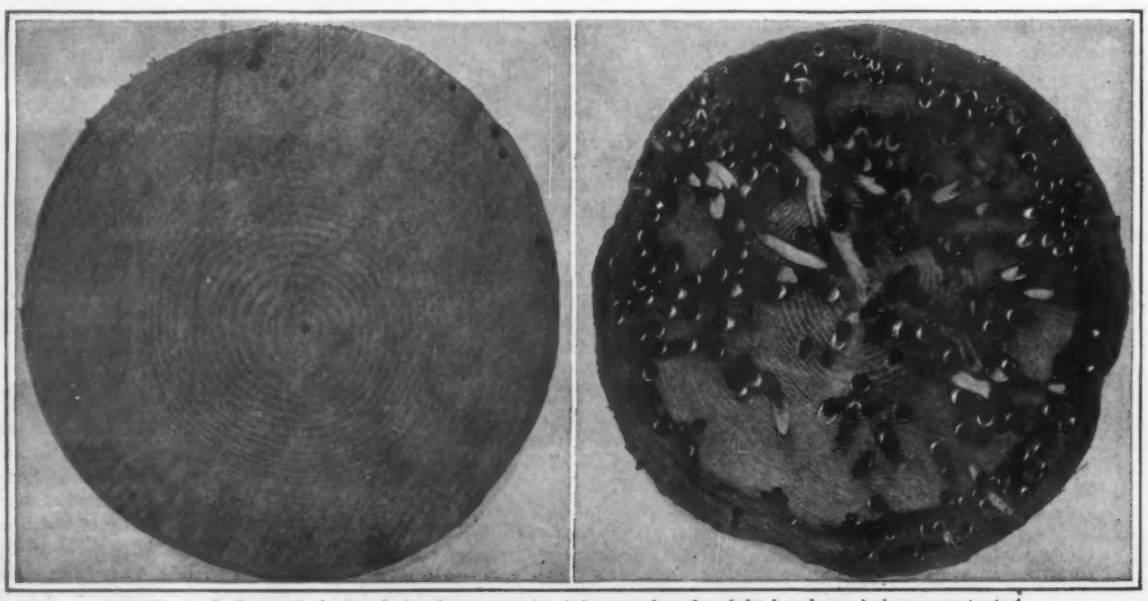
This is to be accomplished by a float of wooden blocks completely surrounding the piling, the blocks revolving upon a connecting chain or wire. By the action of the tidewater these encircling blocks are continuously rubbing and tapping against the pile, rising and falling to the full range of the tide.

Suspended from the ring of blocks are looped chains or wires also surrounding the pile and long enough to reach the mud bottom at low tide. Thus, by the action of the tide, the blocks and the chains combined serve to keep the pile entirely clear of marine growth of all kinds at all times from high water line to mud.

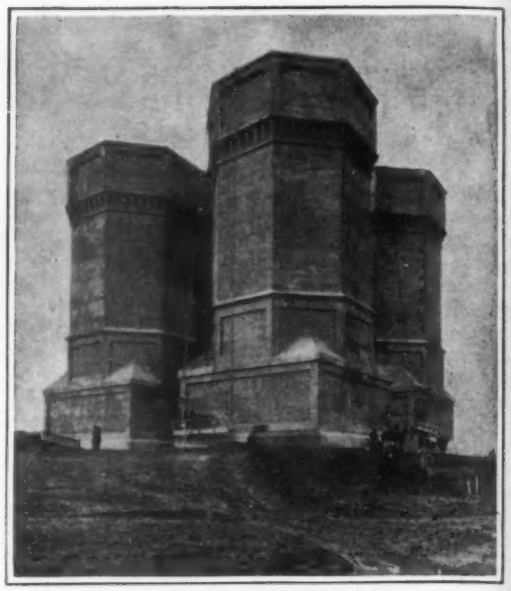
An official experiment with the teredo ring was carried out in San Francisco, beginning in December, 1916, and closing with the pulling of the piles in August, 1917. On December 12th, 1916, the California State Harbor Commissioners drove a green pile near Fisherman's Wharf, San Francisco, and equipped it with one of the teredo rings. At the same time and place two other green piles were driven and left without this protection. The Lockwood protected pile was pulled up on August 25th, 1917, having been in the water eight and a half months, and was found to be sound and free from teredoes, excepting five which had apparently been in the pile before it was driven. A pull of 40,000 pounds was necessary to withdraw it. The two unprotected piles were pulled two days later, and had been almost completely destroyed by teredo and other borers. Neither of the unprotected piles could stand the strain of pulling, and both were broken off close to the mud surface. The illustration above depicts the method of employing the teredo ring and chains, which are of such simple construction that their cost is comparatively slight. In the lower illustrations are shown a section of protected pile and a section of unprotected pile.



The teredo ring in action—it scrapes the borers off before they are able to penetrate



Sections of piles pulled after being in the water eight months, the right-hand one being unprotected, the left with the Lockwood ring



Concrete shells which camouflage unsightly tanks in Cincinnati

The Fortunate English Civilian

ONE of the most educational features of the war has been the increasing necessity of avoiding waste in both production and consumption. Armies must be clothed, fed, and supplied with munitions. To this end the civilian population is called upon to make numerous sacrifices, which are fortunately for its own good in many cases. With a single suit of clothes commanding a price that used to cover a complete outfit from hat to shoes, the people of the United States should derive a great deal of hope from recent provisions made by the British Government for the manufacture and sale of civilian wearing apparel. If Washington follows the lead of London in this respect, Americans will be able to buy a new suit without the amount of self-denial that is now necessary.

English civilian cloths have been standardized, the government controlling the price from raw material to finished garment. There is a fairly wide range of patterns for men's, youth's, and boys' suits and overcoats, and the cloths are of much better quality than those formerly used for ready-made suits, although selling for considerably lower prices. Thus the demand of the fastidious dresser for "something new" may not be gratified, but the average man will be well-clad and better off financially. Of course, an ample proportion of the standard suitings is reserved for those who want their clothes made to order, so that the tailor may be blamed justly if the fit is not perfect. As a basis of comparison with prices in the United States, it may be noted that men's suits in England now cost from $14 to $21.

Just as impressive are the war prices of British shoes for civilian wear. Men's dull-grain derby shoes are now costing $3.71 at wholesale and $4.50 at retail, the corresponding prices of women's stout box kip derby shoes being $3.24 and $4.07, while boys' and girls' split lace shoes command only $1.87 at wholesale and $2.31 at retail.

Neither clothes nor shoes of the kinds just mentioned are being exported, but the American manufacturer interested in foreign trade may gain some valuable hints from their appearance in the English market. In the first place, they are not likely to be dislodged after the war by American wearing apparel of a quality inferior to theirs. In the second place, if they enter later into Great Britain's export trade, as they probably will, they should enjoy a great deal of popularity in the markets where introduced. Stiff competition must be met by American manufacturers of clothing, boots, and shoes, particularly in the British colonies. We shall have to adopt greater economies in our factories and reduce our prices to a level that will enable us to compete with the good and inexpensive products of England.

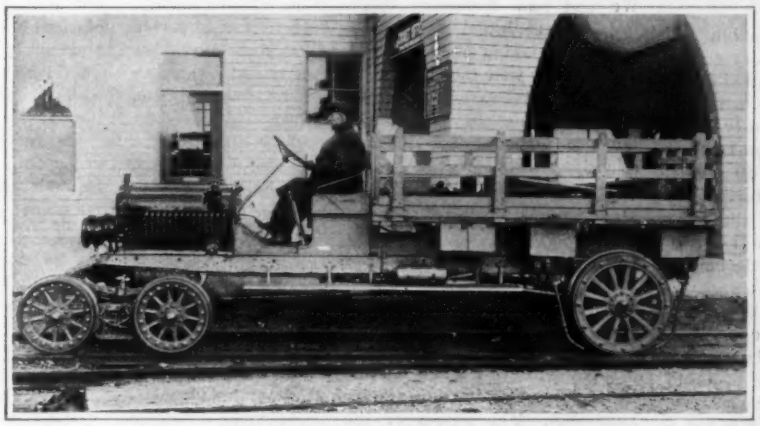
Motorized Railways

Where the Motor Truck Rides on Rails and Takes the Place of the Steam Locomotive

A train on the Tamalpais motorized railroad

IT is not everywhere in the world that a steam railroad can be built and operated with financial success; the vogue of the interurban trolley testifies sufficiently to that. But the trolley is really a compromise between the railroad and the common road, an expedient for combining the power and the reliability of the former with the flexibility and the low construction and operating costs of the latter. When we consider this, we understand better that electric traction is not the only alternative to the steam locomotive. The compromise in question can be carried out in a way still more closely following highway practice, and still more conducive to successful operation under unfavorable traffic conditions.

Here and there, from time to time, a motor truck has been adapted to a special job of logging or of interurban work by fitting it with flanged wheels and running it on rails originally laid for a different kind of engine. Today transportation men are awakening to the fact that in this procedure they have something that can be widely applied to solve the knotty problems of the line which is called upon to supply transportation in small packages. For in the hauling of small units the motor truck on rails has, over the trolley and consequently even more over the steam locomotive, just the advantages that the trolley has over the steam road. As a consequence of this, all over the country we find the flanged-wheel truck going into operation as a locomotive on short lines and feeders and routes over which traffic is light.



The motor truck used as locomotive

An interesting example of the use of the motor truck in this connection is found at Mount Tamalpais, Cal. This eminence is 20 miles from San Francisco; and no tourist feels that he has done his duty by the Golden Gate until he has looked down upon it from the summit of Tamalpais. But people who ride up a mountain side for the view do not constitute traffic sufficiently heavy for economical use of a steam locomotive; and in addition, operating conditions on this particular line are such as to make imperative some kind of special treatment.

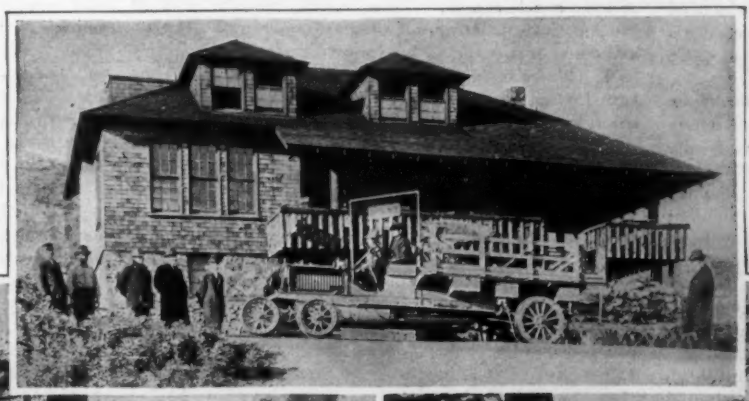
In the first place, the average grade is five per cent; in places a maximum of seven per cent is reached. From a point three miles out, where serious climbing commences, to the summit, the longest straight piece of track is but 413 feet. There is one curve of 90 degrees in a length of 70 feet. At another point the track parallels itself five times within 300 feet, as it winds back and forth up the mountain side.

It is obvious what this means to steam operation. The steam trains have to back up the hill, with the locomotive in the rear. In order to slide around the sharp curves without undue lateral stresses and danger of derailment, pipes are arranged allowing water to run on the rails in front of each wheel, the liquid acting as a lubricant. In no event, no matter what the type of locomotion, is it possible to exceed a speed of 12 miles per hour on any portion of the line.

Accordingly, with the substitution of a motor truck for the engine, there was no reduction in the time of the trip; but in economy and ease of operation there can be no comparison. The trucks used have a four-wheeled pony truck in front, with two driving wheels in the rear. It is an interesting item of the railroad's history to learn that the trucks used on it are driven out from San Francisco on the common roads, under their own power and on the ordinary tired wheels, and the change to the steel-flanged members made when they go upon the rails. The brakes on the four wheels of the pony truck are found sufficient to hold the trains, although of course there are powerful emergency brakes on the driving wheels.

There are no facilities at the summit for turning the car; so it has to back down part of the way to a Y-switch. Accordingly it is necessary to have front and rear sanders on both the driving wheels at the rear.

The Tamalpais line is conceded the position of crookedest railroad in the world. Incidentally, the line which held that rank previously, the 70-mile road from Reno to Virginia City, Nev., has also in service a 30-passenger motor-truck car.



A sample of the curves and grades on the Tamalpais motorized railroad, and (above) one of the stations

A New Field for Women Executives

THERE is an urgent need for women as employment managers, either to replace men called into military service or to meet problems raised by the influx of women workers into industry. A number of big corporations are calling for women to serve in this capacity. To fill these calls and to be prepared for others the free college courses established under Government supervision for the training of employment managers at the University of Rochester and at Harvard have been opened to women.

To be eligible a woman must be at least twenty-five years old, with at least a high school education and not less than three years of actual contact with shop problems, either as worker or as executive. The woman with college training is preferred.

Industrial experience proves that employment problems can best be solved by a separate organization in the factory. The prompt discovery and analysis of unfavorable working conditions can only be made by such a central employment bureau. Most of the improved methods of dealing equitably with the working force have been devised or brought to notice by that new type of industrial specialist, the employment manager.

The man or woman who serves in such a capacity must have an attractive personality, broad sympathies and executive ability. Women who are qualified for it in other directions are therefore urged as a patriotic duty to take the courses that are being offered.

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Fourteen Pounds of Sugar Out of Ten

MR. J. J. WILLAMAN, a member of the American Chemical Society, has suggested a method whereby sugar may be persuaded to do more work for us.

There are many kinds of sugars, their names ending in -ose. Sucrose is the correct name of cane sugar, glucose for starch sugar, such as corn, maltose for malt sugar, fructose for sugar from ripe fruits, etc. They are all composed of carbon, hydrogen, and oxygen in various combinations sucrose being expressed as $C_{12}H_{22}O_{11}$, and glucose as $C_6H_{12}O_6$. Now when sucrose is acted upon by acid under the correct conditions it becomes hydrolyzed and is converted into an invert sugar which is a mixture of 50 per cent glucose and 50 per cent fructose.

Fructose is characterized by its excessive sweetness, being considered approximately 30 per cent sweeter than sucrose, our usual cane product, compared pound for pound. One hundred pounds of cane sugar will yield 105.24 pounds of invert sugar which in sweetening power equals 135 pounds of cane sugar or sucrose. The food value remains about the same but since we customarily use sugar for its sweetness and not its food value, we have made a distinct gain.

Invert sugar will not crystallize and the public has become accustomed to granulated and other dry sugars so if it seems attractive to use invert sugar our kitchens may be called upon to prepare it. This is a simple matter for the reaction is one which frequently takes place in jelly making and is used to advantage by food product concerns. A convenient formula is: to 10 pounds of granulated sugar add four and one-half pints of water and one-fifth of an ounce of tartaric acid. Boil the solution slowly in a covered vessel for from thirty to thirty-five minutes, taking care to discontinue the boiling before the color of the solution darkens and a corn sirup taste develops. When properly carried out the operation yields about fourteen pounds of a sirup, one pound of which is just as sweet as one pound of the original 10 pounds of cane sugar and three-quarters of a cup of which will do as much sweetening as a cup of the sucrose.

There are several reasons why invert sugar is not a better known article of commerce such as manufacturing cost and merchandizing difficulties, but it may help us to make our two pounds of sugar seem two and eight-tenths pounds while we willingly remain on rations.

An Industry to Order in a Hurry

CONSTRUCTION frequently seems slow but how long would it take if the builders were required to design and create their tools before they could begin, and even make the instruments necessary in designing? The task confronting American chemists in 1915 when it began to be plain what shortages were to be met was somewhat similar and yet many users of chemical products became impatient and even abusive because a chemical industry could not be shaken out of one's sleeve, magic fashion.

When the machinist or the contractor is called upon to multiply output or to undertake a new product many problems are presented but the apparatus is usually available or may be designed using easily obtainable materials. The chemists' task in providing our country with a chemical industry has been so entirely different and so much more difficult that it seems worth while to touch upon a few of the adverse conditions which obtained in the late summer of 1914 and to indicate something of what has been accomplished in overcoming them.

There are many reasons why Germany should have become headquarters for chemicals and apparatus used in chemistry. These lines of manufacture require much more labor than raw materials and they are well adapted to the home industry plan so generally followed there in addition to large factories. Whole families engage in glass blowing, purchasing their tubing at local headquarters and returning the finished articles which vary according to the skill of the maker. The children make test tubes and other very simple forms while their elders undertake complicated condensers, bulbs and extractors. Small laboratories may concentrate on the production or purification of a few chemicals, notwithstanding the existence of large works, and these are marketed through well known dealers just as the alcohol produced in small quantities by the farmer reaches market through some central organization. And have we not been taught that to be reliable it must be "made in Germany?"

On numerous occasions, however, it has been demonstrated that such a condition was unnecessary, but Americans, and especially the educational institutions, required to get the most for the dollar, have either refused to pay a reasonable price for the American-made product or have used the German price as a club with the result that efforts stopped. You can not run a business on unsupported patriotism. The manufacture of materials essential to scientific progress continued to be centered in Germany, and, eventually, if it were only "made in Germany," no questions were asked while tests which would have disclosed faults were considered unnecessary and were omitted. That label was clever propaganda and much has been spent to establish it, just as coined words have become so established through advertising that American manufacturers now find difficulty in selling the identical material under any other name even under present circumstances.

This is another example of German planning. If you can make the world dependent upon you for a few small but essential things you are in a commanding position. The idea has been followed even in German retreats where in France *the same small essential part* was removed from all mowing and reaping machinery so that not one workable machine could be assembled from the wrecks.

Fortunately there were some exceptions. A few instrument makers in this country had for years made excellent apparatus though not chemical glassware. We had had decreasing difficulty in placing optical instruments abroad although we had to use imported glass for making the lenses. Analytical balances the equal of any were made here and, more lately, acceptable fine chemicals began to be supplied. The idea of putting an analysis on the label was American and has done much to further the sale of American made chemicals for scientific work. We have always been producers of enormous quantities of commercial or technical chemicals for large-scale manufacturing purposes, but it is some of the compounds required in research, analytical and control work that have been lacking.

Now bear in mind that the metal industry, the production of explosives, of lubricants, of paints, safe transportation, food supply and nearly everything industrial is dependent in some measure upon chemical control. When war came the English steel makers actually faced a grave situation due to the lack of small parts of chemical apparatus. The navies of the world were equipped with optical instruments made with German glass. That the need existed is apparent and to meet it required some of the best work much of which has been in obscurity and unsung, unmentioned in dispatches and no doubt considered unessential by some draft boards.

The peculiar requirements for chemical glassware and porcelain introduced technicalities in manufacture that had to be learned. They are not to be found in patents or text books and yet at this time our shortage is practically overcome. The Bureau of Standards has published the results of tests in American chemical glassware in comparison with the leading European ware and the conclusion is: "These results indicate that all the American made wares tested are superior to Kavalier and equal or superior to Jena ware for general laboratory use." These tests were on five American wares and the two foreign makes named. They were designed to show how well the glass in question would withstand the treatment it must be given in service and included, besides determination of composition, resistance to heat shock, dropping, and strain, refractive index, coefficient of expansion, evaporation test and solubility in acids, caustic and carbonate alkalies, sulfides, phosphates and chlorides. The tests were made more severe than the ware would usually be called upon to withstand but were not unreasonable for chemical glassware. Thus vessels containing boiling water were plunged into ice water and those with paraffin heated to 150 degrees C. (302 degrees Fahr.) over a direct flame in them were similarly treated as were also those heated to 200 degrees C. (392 degrees Fahr.). The drop tests involved dropping the glassware upon a hardwood board from increasing heights until breakage occurred. On this test the American glass was far superior.

Is it not interesting to note that American chemists could have had home-made glassware just as satisfactory as at present 12 years ago? Much the same glass was offered to them then but besides being of higher price it was not "made in Germany" and our eyes were not fully open then.

Besides glassware the chemist requires many articles which he has had to provide before the work we have all been so anxious to have completed could be properly carried out. The Kaiser himself has been reported to be the owner of the factories which have had a monopoly on laboratory porcelain. Like chemical glassware such porcelain is called upon to do many things which porcelain as it is generally known can not do. Sudden changes of temperature, very high heat over bare flames and chemical action are some of the requirements. Several American concerns undertook the solution of this problem involving complex raw materials and specialized technique and today just as fine, if indeed not superior, porcelain may be had made in America as formerly came from the royal potteries. One of our most satisfactory wares is made in an old brewery driven into useful pursuits by progressive legislation.

Chemistry has had to find its own substitutes and has not been free from a shortage of supplies. With a serious shortage of platinum, chemistry, the most important user, has been the only one to endeavor to use substitutes. At least two new alloys have been devised which can be used for a part of the work though not as a catalyst which is the all-important service. These alloys include combinations of palladium, gold, radium, titanium and other rare metals. Fused quartz vessels, either opaque or transparent, including cascade dishes, tubes and special shapes have been perfected and these very greatly facilitate manufacture, especially the concentration of corrosive chemicals, besides adding an important class of apparatus to the research and testing laboratory. The technical difficulties in melting quartz and casting or pressing it into shape are quite formidable and the finished ware is remarkable. It has a coefficient of expansion so low that it may be heated red hot and plunged into ice water without fracture, hydrofluoric acid of all the acids is the only one to attack it, while it will withstand alternate heating and cooling indefinitely without change.

Entire methods of procedure have been changed in order that some material other than platinum could be used and this has extended to complex electrolytic reactions in organic chemical manufacture where platinum had been thought indispensible as electrodes.

And with all this effort to release the maximum of platinum for essential work some people continue to buy platinum jewelry!

In many places where potassium salts were considered indispensable chemists have had to learn how to use sodium compounds and have been successful with the possible exception of some varieties of optical glass for which we are able fortunately to produce our own potassium carbonate. We have lacked certain unusual organic chemicals for which the demand is so small that manufacturers have not been justified in taking up their production, but they have been forthcoming, some from the laboratories of our universities. Thus these have suddenly become obviously practical when many thought them purely theoretical and academic.

Our balances leave little to be desired and in many respects they are superior to the imported ones which are to be found in many of the older laboratories especially those of our universities and colleges. Until the war we knew little of any polariscopes, refractometers and similar optical instruments save those of middle Europe. At least one English manufacturer has always made excellent spectroscopes and to add other types of optical instruments to his productions has been a natural step. Thus another German monopoly has been broken and it will continue to be our duty to support those manufacturers who have come so splendidly to our relief.

Just as the step from the laboratory experiment to commercial-scale production process frequently presents as complex a problem as did the original research, so the provision of commercial size apparatus for chemical manufacture has been as difficult as the production of laboratory utensils. One of the reasons advanced by the pessimists for their contention that America could not have a chemical industry was the absence of suitable apparatus and the plants in which to construct it. The need has been amply supplied and while there has been some delay in deliveries, this was not unreasonable and generally the efficiency of the machinery has made it well worth the waiting. Americans have developed special alloys, new types of resisting iron, have found clays to replace imported ones, and have produced castings of various metals of a quality to command a foreign market. There have been many difficulties in glazing, enameling and plating to overcome. New acid and heat resisting cements have had to be devised. Drying problems have called for new methods and apparatus and means for controlling the rate and manner in which the moisture must be removed. The mechanical engineer has had his task in vacuum apparatus, conveyors, stirring devices, etc. But the coöperation of American engineers backed by American capital has brought success in manufacture as well as in providing the necessary tools for laboratory research.

This success will hardly be real and surely not permanent unless America continues its support after war and thus demonstrates its appreciation for the present, and faith in the future, of an American chemical industry.

The Atkins intermittent spring, at normal state (left), and at its periodic maximum (right)

The Intermittent Siphon in Nature

A Curious Spring in Virginia Whose Flow Appears to Be Governed by This Principle

By Ellis W. Shuler, Ph.D.

SPRINGS have, in all times and places, been objects of special regard and veneration. Primitive man enshrined them with guardian spirits; even today the most world worn of the modern generation has the wonder spirit aroused when, standing by a beautiful bold spring, he sees the miracle of its never ceasing flow. Give the spring some unusual quality and Greek and pagan alike made it a shrine; but in this day of science it only provokes a closer study until its often commonplace secret is revealed.

The intermittent spring is, in many text-books on physics, a stock illustration of the principle of the intermittent siphon. It is given considerable space in that delightful old text-book of the last century, Comstock's Natural Philosophy. In the 11th edition of Ganot's Physics there is an excellent summary discussion of the subject:

"In the intermittent siphon the flow is not continuous. The siphon is arranged in a vessel, so that the shorter leg is near the bottom of the vessel, while the longer leg passes through it."

We illustrate the glass tumbler with hollow stem for the insertion of the curved siphon tube, familiar to many physics laboratories.

"Being fed by a constant supply of water, the level gradually rises both in the vessel and in the tube to the top of the siphon, which it fills and water begins to flow out. But the apparatus is arranged so that the flow of the siphon is more rapid than that of the tube which supplies the vessel, and consequently the level sinks in the vessel until the shorter branch no longer dips in the liquid, the siphon is then empty, and the flow ceases. But as the vessel is constantly fed from the same source the level again rises, and the series of phenomena is reproduced."

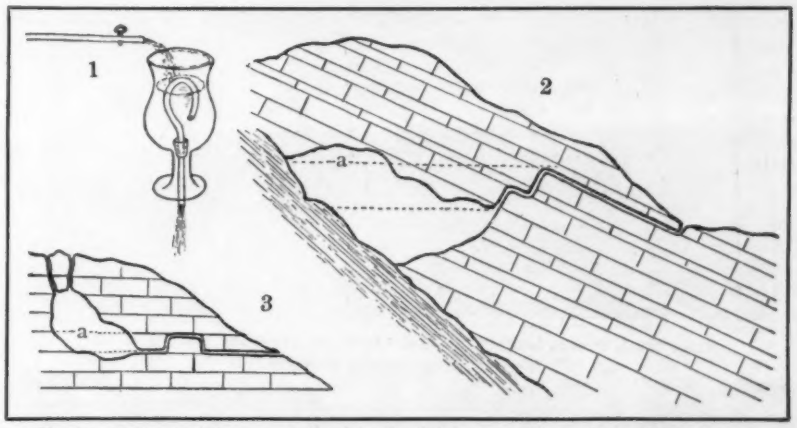
"The theory of the intermittent siphon explains the natural intermittent springs which are found in many countries."

Having made a visit to such an intermittent spring in southwestern Virginia, the writer was surprised to find, after a long search in the library of Harvard University and the Boston Library, that the occurrence of intermittent springs is extremely rare and that there are few descriptions of them.

Dr. Albert Heim's monograph, Die Quellen, refers to intermittent springs in the Karst region, and also in Bavaria. Dr. Atwell in the Philosophical Transactions, Devonshire, England, cites an excellent example near Giggleswick in Yorkshire. This reference is given in Ganot's Physics. W. B. Rogers' geological report on Virginia, 1842, refers to a "flowing spring," which doubtless belonged to this class.

Various theoretical shapes of siphons and reservoir conditions for intermittent springs are illustrated herewith. In each case, if the reservoir fills up to the level "a," the water will start running out through the siphon channel-way and will continue to run until the water is lowered in the reservoir to the end of the short arm of the siphon outlet. Three conditions are necessary for intermittent flow in a spring: A reservoir, a siphon exit channel-way, and the further condition that the quantity of the inflow into the reservoir be of less volume than may flow out through the siphon exit.

The intermittent spring described below is found near Atkins, in the mountain region of southwestern Virginia. It is located on the edge of a narrow meadow at the foot of a low hill on the farm of Mr. John Atkins. Locally it is known as the "flowing spring."



The intermittent siphon as realized in the laboratory (1), as the author assumes it to exist in the Atkins spring (2), and in a third arrangement which might be found in nature (3)

The spring is situated about two hundred yards from the fault contact between the heavy bedded Cambrian dolomite of the Great Valley, and the Mississippian shales of Brushy Mountain. The dolomite dips at an angle of about 30 degrees to the southeast. The shales dip in the same direction but at a steeper angle. Along the plane of this fault, to which the name of Walker Mountain fault has been given, in many localities there are caves and solution cavities; and the writer has illustrated the probable relation of such a reservoir cavity along the fault plane, which is connected to the Atkins spring by a siphon channel-way. A corroborative bit of evidence that the reservoir is located along the fault plane, is that the water is "softer" than in the majority of springs originating in the dolomite of the area, and it is inferred that the bulk of the water seeps along the fault plane over the shales into the reservoir.

The rapidity with which the reservoir fills and the Atkins spring "flows," depends upon the season and atmospheric conditions. The interval of time between the "flows" when observed by the writer during a dry season, and a high barometer, varied from 50 to 70 minutes. It was reported that during a rainy season the flow might occur as often as every 30 minutes. The period of the flow was said to increase in frequency with a low barometer, and just before a rain.

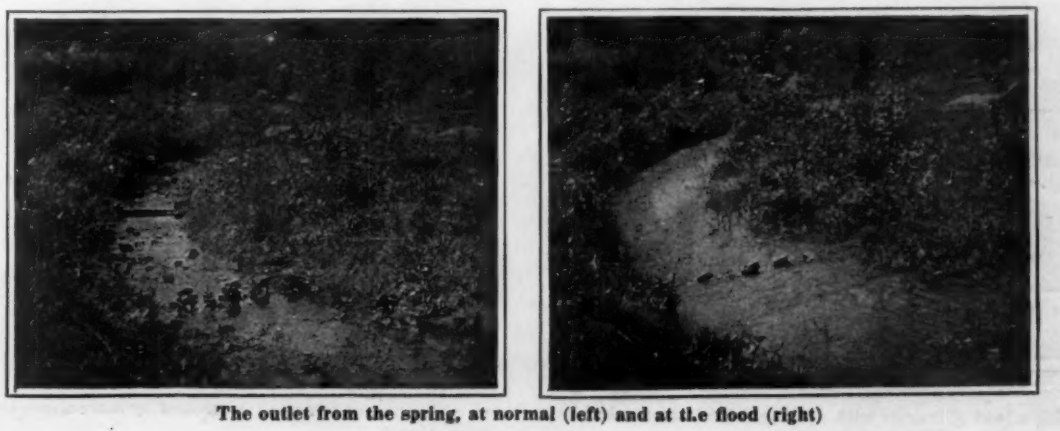
The Atkins intermittent spring is fed from sources outside its siphon reservoir, and so at all times furnishes a small constant stream of water. The normal condition of the spring and the spring branch is illustrated. At regular intervals, varying with weather conditions, the stream is augmented from the siphon reservoir so that it fills up to a higher level, and the tide passes down the spring branch.

The flow continues from seven to ten minutes. It is gradual and reaches its maximum height in about four minutes. There is no bubbling or evidence of gas. The rise in the spring is silent. The increase in the volume of the branch is, of course, heard in the murmur of the water. Following the tide, the spring again subsides to a quiet steady flow.

An effort was made to estimate the size of the reservoir by noting the increased velocity and depth of the spring branch. This gave roughly, a reservoir capacity of from seven to ten barrels.

What is the probability of the occurrence of an intermittent spring? The primary condition of a reservoir can be met in many springs in areas underlain by limestone; though such reservoirs would probably result from accidents, such as the choking up of a cave by infalling blocks, or debris, rather than as the result of normal solution action. Still, they must be fairly common.

If the spring siphon owes its origin to solution along joint planes in the limestone, then the chance that the elbow of the siphon be air tight is a small one. Further, any increase in the necessary number of angles in the siphon tube, will decrease the chance of its occurrence. Comparison of our drawings "2" and "3" will illustrate this; and even in "2," two bends could be eliminated. The fortuitous concurrence of reservoir and siphon tube, is very rare, as the lack of literature on the subject shows.



The outlet from the spring, at normal (left) and at the flood (right)

The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGÉ, M.S.A.E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Army Truck Trains

MUCH has been written about the work motor trucks have done in the present world war and their accomplishments are now a matter of history with which all those interested in motor truck operations are familiar. To secure the results it is necessary to organize the motor truck drivers and their vehicles into units which are known as truck trains or motor truck companies. This is a tactical unit which is handled in just the same way as any other unit comprising an army would be. Each truck company is intended to be complete in itself and to have the necessary executive officers for the administrative work involved and competent engineering personnel to make sure that repairs are properly made and that the trucks are handled as they should be.

As ordinarily constituted a motor truck company consists of about thirty-three trucks, 30 of which are load carriers while the other three are service vehicles which accompany the train. One of these may be a kitchen and food supply truck, one a mobile repair shop equipped with machinery and tools for making necessary repairs, while the third one is generally an emergency truck equipped with various tools for salvaging wrecked trucks and carrying tanks holding a reserve supply of fuel, lubricants and in some cases, water. The organization and composition of the truck train depends entirely on the work it is to do and the three service trucks are not included unless the truck train is on field duty. As will be seen by the accompanying illustration a motor truck train occupies quite a stretch of roadway even when trucks are very close together. When running in proper formation a

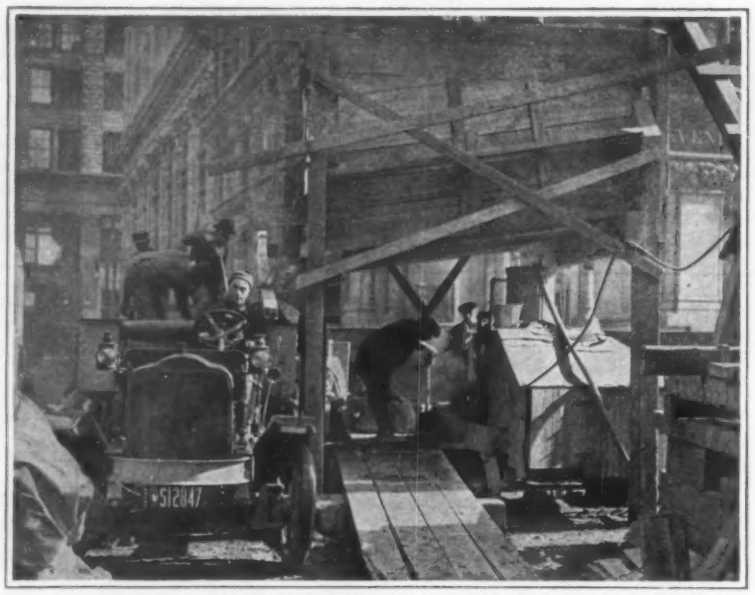
(Concluded on page 140)

Army motor truck train or company in close formation, showing road space occupied

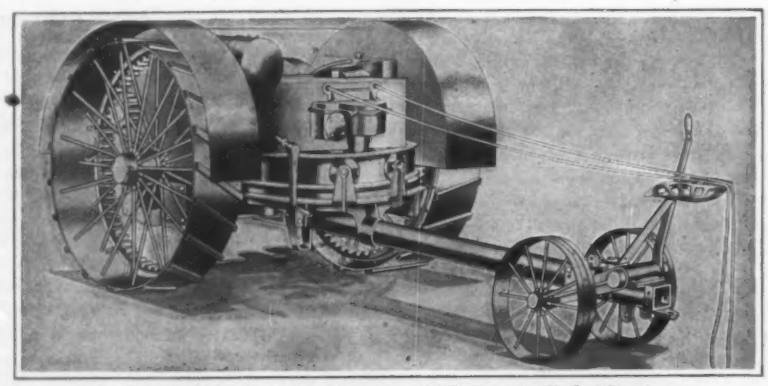
Motor Trucks Essential in Building Subway

MOTOR trucks are playing an important role in the building of Philadelphia's new $65,000,000 subway improvement. While this stupendous engineering project is expected to take years to complete, the excavation for the central terminal station to be located underneath the City Hall building has been practically completed and a fleet of five-ton trucks has been busy for months hauling thousands of tons of earth, rock and shale to a dumping ground five miles distant. Engineers of the construction company in charge of the improvements, say that the hauling of the excavated material was one of the most formidable transportation problems they have ever faced. The City Hall is the dividing line between North and South Broad street, in the heart of the city's most congested business district and traffic on all four sides is extremely heavy.

In order to care for the huge quantities of earth and rock removed daily, four or five loading bins were erected at different points near the outside walls of the building and one large bin inside the courtyard. The work of removing the soil from the tunnel and lifting it into the bins progressed rapidly but for a time inadequate transportation facilities to haul it threatened to halt the improvement. The long continuous hauls of heavy loads from the bins to the dumping grounds forced the first hauling contractor using a fleet of less powerful trucks to forfeit his contract. The company then entered into an agreement with Stedman Bent of Philadelphia a progressive hauling contractor, who owns a fleet of 66 five-ton trucks and there was no question about his being able to give the kind of service that the construction company demanded to rush the subway improvement. Mr. Bent was able to furnish as many trucks as the company could use and they proved so successful in their operation that later the fleet was enlarged and the additional trucks used to haul thousands of bags of cement, sand, gravel, crushed stone, lumber, tools and various other supplies. At the present time a fleet of eight trucks are hauling over 500 yards of earth and rock a day over a nine-mile course. The yardage could be doubled if conditions at the dump were better. When the work was started the ground was covered with from three to five inches of water and below this was soft black muck and in many places quicksand was encountered.



Motor truck beside loading bin into which are lifted the masses of dirt excavated in subway building



Rear end of the line-drive tractor, which is controlledwith reins, showing arrangements for driving "light"

General Utility Tractor Controlled With Reins

BRIEF mention has been previously made in these columns of a distinctive form of tractor that is really a mechanical horse inasmuch as it can be controlled by a pair of reins and attached to any form of horse-drawn vehicle or agricultural appliance without any change to the vehicle to which it was attached. As the control is through a pair of reins the operator can ride on the load just as is the case when animal power is used for traction. With ordinary forms of tractors some forms of machines require two men, one to drive the tractor and one to ride the load. For example, with the line drive tractor, in harvesting the one man that rides and operates the binder also operates the motive power, as the engine is driven with a pair of lines or reins just as though horses were used. It is also stated that this machine has advantages which merit its use by contractors engaged in road work or in any heavy teaming. It is believed that the control makes it particularly well adapted for use by mechanically inexperienced operators because any one who can drive a horse can properly control its mechanical successor.

Information just received makes it possible to give a more detailed description of this novel machine. The machine is provided with four wheels, two of which are used only to support the pole and carry the driver when the tractor is not attached to

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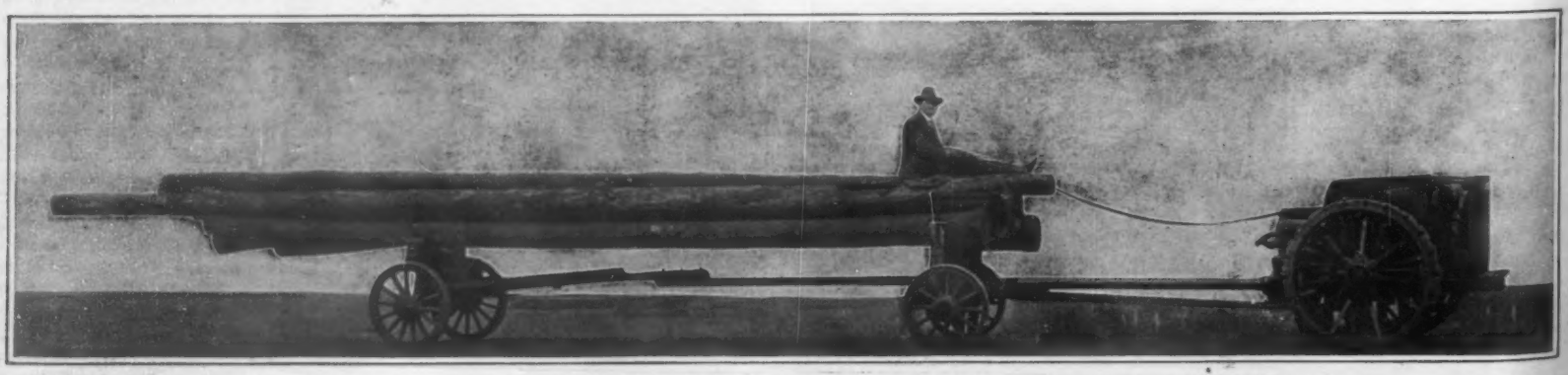
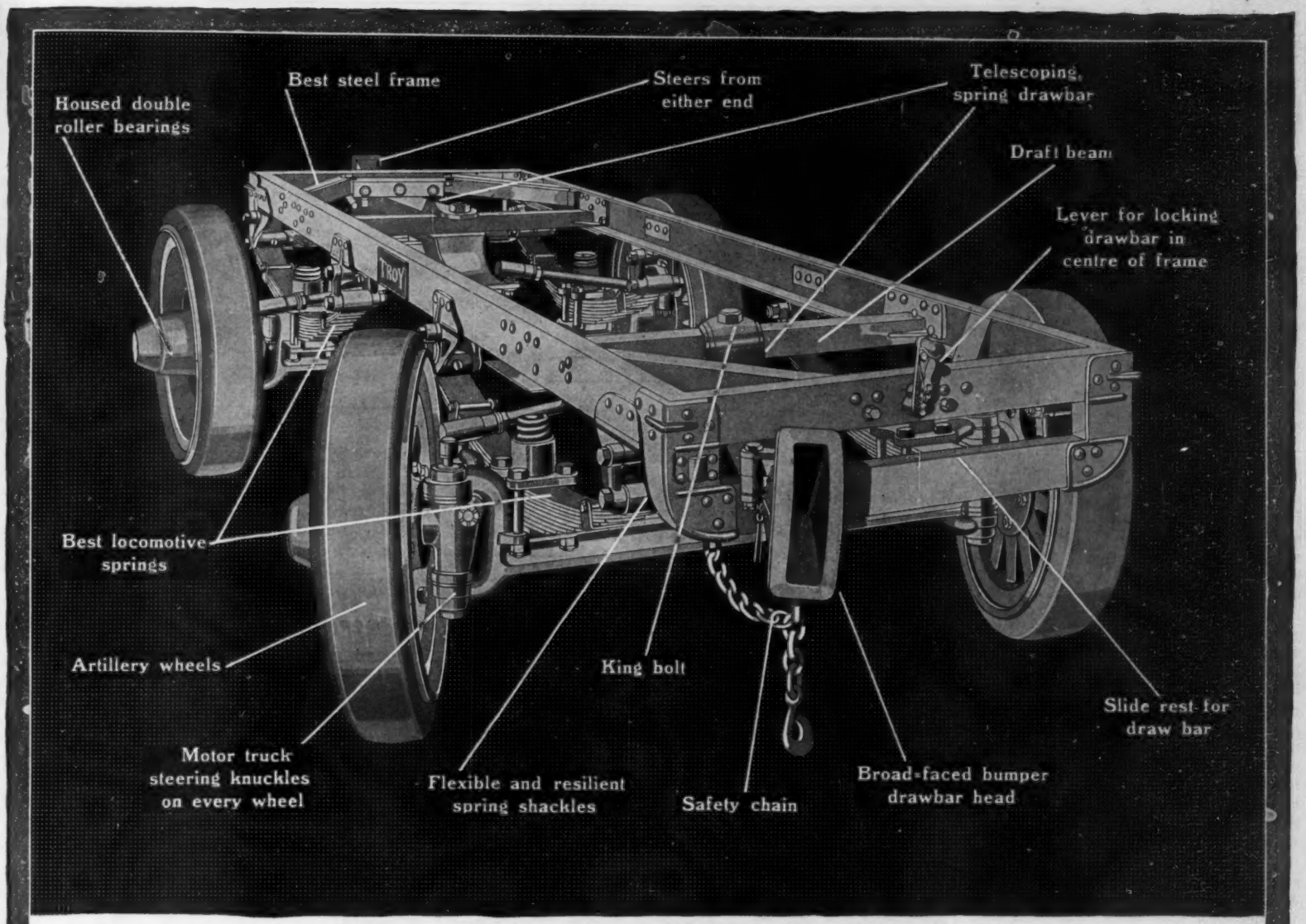


Hauling a load of lumber with the line-drive tractor, which is operated with a pair of reins and controlled by movements similar to those used in handling a horse



Four wheels and a frame won't make a trailer to be operated behind a motor truck.

A motor-truck trailer must be so designed that every wheel takes care of itself when meeting road obstruction. There can be no whipping motion. There can be no side-thrust in rounding corners,—no strain on wheels, frame or steering gear. The wheels must always be parallel to the line of traction.

There must be an absolute automatic steering mechanism, so that whether there are one or more trailers in the train, each one will follow in the exact track of the truck, 'round corners and regardless of road conditions.

There must be prevented any and all shocks from sudden starts and stops.

To travel for 4 to 15 miles an hour and under load—to back into or pull out of a crowded corner—to hitch up to any truck and stay hitched,—to take any road day after day, without injury to itself or to the truck,—to pass through a narrow gateway on a curve without collision—in a sentence, to meet and extend all the desirable conditions of modern trucking traffic at a profit to the operation, and to remain a sound, dependable mechanical asset in an enlarged scheme of transportation, calls for a vehicle such as was never before designed.

Troy Trailers

have gone through all of this evolution of design and test, re-design and re-test—and then years of experiment in actual service,—and they havs done this with wonderful performance.

Troy Trailers do not contain a single wagon part. They are built entirely of bronze and steel, with wood only in the wheels.

Compound draw-bar heads and couplings allow unimpeded motion in the connection between the truck and trailer. The trucks can be attached to either end of the trailer.

These coupling features take not only the up and down and sideway fluctuations, but all the angles in between.

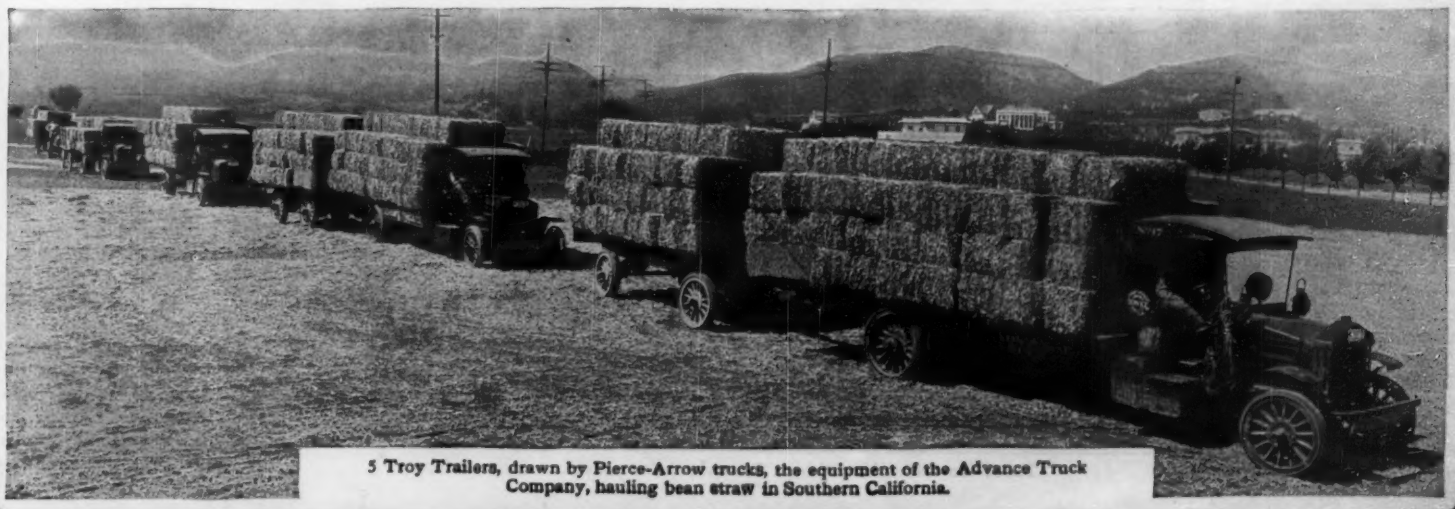
The "pull" is through the frame and springs, and not on the axles and wheels. In other words, the load itself starts to move before the wheels do.

As much engineering skill is required in building Troy Trailers as it takes to build the best trucks.

Troy Trailers are made in from 1 to 5-ton capacity, and with any type of body desired.

The Troy Wagon Works Co.
Troy, Ohio

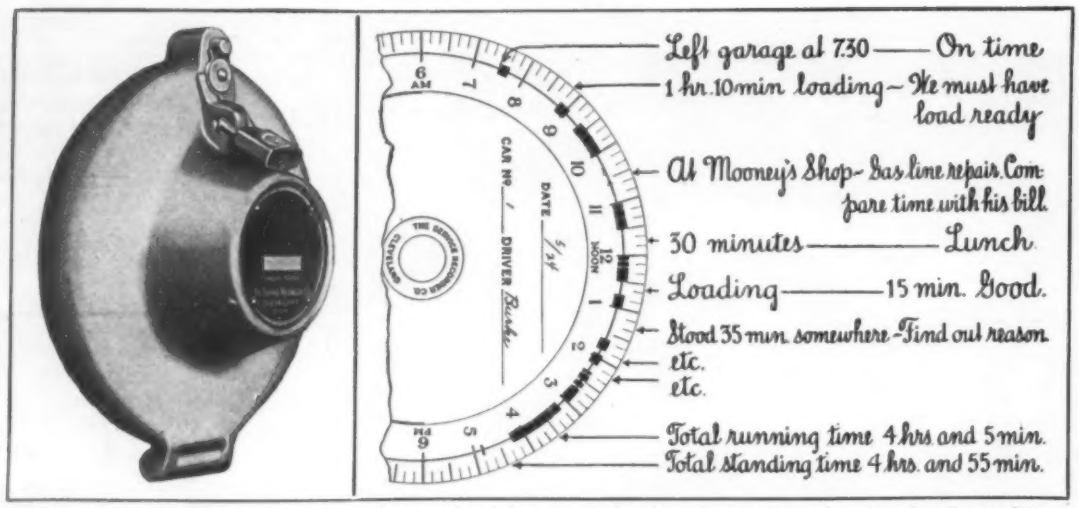
Oldest and largest makers of Trailers, making possible highest grade construction at lowest cost



5 Troy Trailers, drawn by Pierce-Arrow trucks, the equipment of the Advance Truck Company, hauling bean straw in Southern California.

Keeping Score of the Motor Truck

MORE than one suggestion has been put forward to facilitate keeping track of the daily movements of the motor truck, and to advance this operation from guesswork to an exact science; but few if any of the devices have seemed at once so simple and effective as the one we illustrate.



The motor-truck service recorder, and a sample of the record showing what the boss thought when he read it

The principle involved is the familiar one of side-sway in moving vehicles. It is a well known fact that even a Pullman car travelling over a relatively smooth and straight stretch of track exhibits a certain amount of side-sway. In a trolley car approaching along a straight track an almost regular lurching from side to side can be detected, amounting often to as much as three or four inches. In the motion of the motor truck this side sway is very pronounced, and is present no matter how smooth the road or how straight the line of travel. It is entirely distinct from vibration, and should not be confounded with the latter.

This side-sway, then, tells us that a vehicle, whether motor-truck, horse-drawn wagon, locomotive, or even motor-cycle, is in travel motion; absence of side-sway indicates that the vehicle is standing. The problem suggested by this is then to make an instrument which will record side sway and record when it occurs.

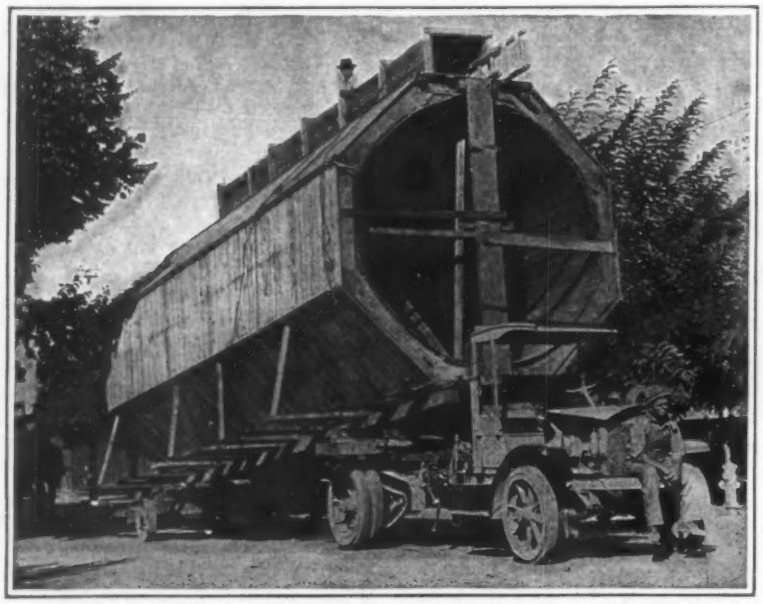
The device pictured consists fundamentally of but two elements; a pendulum mass which will swing from side to side in response to the side away of the moving vehicle, and a chart rotating at clock speed, upon which the pendulum can mark a record which indicates that side-sway, and hence travel, is going on. Of course, the absence of this record means that the vehicle is standing. The pendulum itself records its oscillations on the chart, by means of a stylus set in it near the point of suspension.

An idea of the record which is made by this device may be obtained from the fragment of the circular dial pictured. To a person not acquainted with the truck or vehicle in question, a chart of this kind seems to present merely a succession of periods of running and standing time. But the truck superintendent or dispatcher knows in advance the work which the truck has had to do, and finds no difficulty in identifying the various trips and stops, and describing them as shown in the chart already referred to. The next and obvious step is to cut down those delays which are not warranted and thus increase the running time of the truck to a maximum.

While the commercial utility of this device is very apparent, it is possible that, during the war, its military use may be even more important. Anyone who is acquainted with military affairs knows that the average officer spends an important part of his time in making out reports of various kinds, giving a time record of his activities during the day. Officers in charge of motor vehicles are generally required to make reports covering the movements of those vehicles, with special reference to the exact periods of time in which the trucks, passenger cars, motor-cycles, etc., are running and standing, when they started and stopped, and the total running and standing time for the day and night. To assemble this information by human means is laborious and often inaccurate. This recording device, on the other hand, gives all this information accurate to the minute, and not only relieves the officer of the burden of getting the data together, but enables him to render accurate and complete reports of his operations.

Trailers Increase Truck Capacity Greatly

THE use of trailers as additional load carriers to be drawn by loaded motor trucks when road conditions permit is increasing despite the opposition to the use of such vehicles that obtained for some time and which was generally voiced by motor truck builders and designers. There were legitimate grounds for complaint because motor truck construction was not strong enough at the time this practice was discouraged but inasmuch as many truck users decided to employ trailers the manufacturers of trucks were forced to strengthen the frame and power transmission parts to resist the increased stresses imposed on the mechanism when drawing loaded trailers. Three forms of trailers have been adapted for use with automobiles. First and simplest of all, light two-wheel forms have been built for use in connection with passenger cars and are provided with automatic couplers so they may be easily attached to simple fittings that become a permanent part of the passenger car chassis and so they may be as easily detached when their day's work is completed.

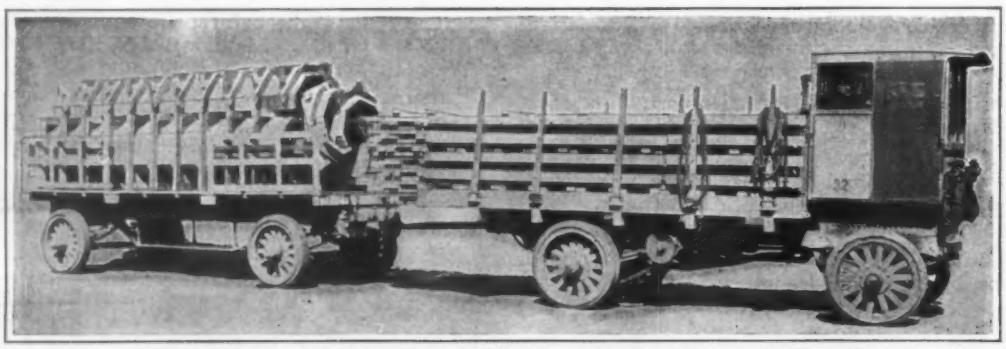


Silo, with a capacity of 47 tons, which was hauled five miles on a three-ton truck and semi-trailer

Semi-trailer forms have been built that can be used only in connection with specially built road tractors which have a turn-table or fifth wheel attachment to receive the front end. These may be made in infinite variety and as the illustration herewith shows almost any form of wheeled vehicle may be used in connection with these tractors. This construction is especially adapted for moving heavy loads, and in the case illustrated a three-ton truck is shown hauling a heavy silo which has a capacity of 47 tons and which was moved by the truck and semi-trailer combination a distance of more than five miles. By far the most popular form of trailer is the four-wheel type having all wheels carried on steering knuckles so joined by levers and connecting links that the wheels will track with those of the leading truck when rounding curves. These trailers are made in varying capacities and are provided with solid rubber tires. The trailer of the two- to three-ton capacity has four-inch tires while that with a capacity of five tons has 7-inch tires. The wheel base of the five-ton job is 18 feet. Automatic couplers are provided at both ends of the running gear so that the trailer is really reversible and several may be joined together to form a road train behind any truck of sufficient capacity. As the trailers are called upon to carry all of the load, the motor truck is not intended to carry any weight except that loaded in its body. In the semi-trailer type part of the load is carried by the tractor rear wheels and we have what is, in effect, a six-wheel automobile which is articulated in the middle so the front and rear may assume different angles to facilitate steering.

The amount of load a truck will pull when used as a tractor or in connection with trailers depends entirely upon the power available and the character of the highway over which the truck is operated. The final drive ratio and method of final drive also have material influence on the hauling capacity of the truck. Whenever truck manufacturers offer optional ratios which are lower than their standard ratios of final drive, these should be specified if the truck is to handle trailers. A rough-and-ready rule is that the average truck of good construction will pull a loaded trailer of the same capacity as the rated load capacity of the truck without strain. Where the maker has strengthened the frame construction and has provided spring mounted towing hooks trailers may be used without injuring the towing chassis.

It is hardly necessary to point out that trailer economy is not dependent upon increased loads alone. Quite as much benefit is derived from economy of time. The truck need never stand idle for a moment during loading or unloading; it can drop its trailer and be off at once.



Five-ton capacity trailer coupled to five-ton truck, thus doubling truck's capacity

Three-ton trailer hauled by a four-wheel-drive truck, carrying lumber

The Current Supplement

PRACTICALLY all of the explosives used in the war are nitrogen compounds, and considering the immense quantities burned every hour of the day by all of the great armies in the field it can be easily appreciated what an important matter an adequate supply of ammunition is. Our original source was Chile saltpeter, but dependence on this is precarious, especially in view of the shortage of ships. Various other sources of supply are now possible, and an excellent review of these will be found in a paper on *The Nitrogen Problem in Relation to the War* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2224, for August 17th. Those who have made a study of the American Indians are aware of the fact that their medical practice did not consist wholly of conjuring tricks and invocations of spirits, but that they had a very considerable knowledge of the medical properties of herbs and trees, and that many of their remedies possessed real value, although but scant records have been preserved. An article on *Indian Medicines* gives the results of a careful study of the remedies that were obtained from trees, and it is accompanied by a number of illustrations. *Familiar Scenes in a Modern Shipyard* shows operations in wooden ship building, with brief notes on the subjects illustrated. Bread is the staff of life, but owing to the present excessive demands for wheat, which apparently greatly exceeds the possible production, under existing conditions, substitutes are being carefully considered. Among these is corn, a material which, although consumed by human beings to a large extent in America, is but little known, or understood, by people of other countries. In an article on *Corn Is King*, the question whether this grain will become the base food of the world is discussed, in view of its prolific yield, and ease of culture. *The Madsen Automatic Gun* describes and illustrates in detail a machine gun that is highly thought of abroad, and a study of its construction will give an excellent idea of the principles involved in this class of weapon. The paper on *Ports and Terminal Facilities* is concluded in this issue.

Postal Motor Trucks

(Concluded from page 127)

operation of any such service is dependent upon three primary factors: The highway, the vehicle and the commercial convenience of the patron. The two latter are variable factors—some trucks are better than others and some communities take more kindly to parcel post than others.

But the highway is a fixed factor. Its cost, location, maintenance are all matters of figures. Hence a great program can be considered in definite figures.

The use of state highways by government owned equipment for profitable enterprise without compensation to the states except in improved mail facilities to residents is not equitable. The Federal government may be under a moral obligation to reimburse the states in some substantial manner. The post office believes this can be done with benefit to the states and at the same time further increase the profitable possibilities to the Federal government by building and maintaining roads.

A joint resolution under consideration in Congress authorizes the use of not more than fifty per cent of the gross earnings of motor truck parcel post routes for the construction and maintenance of the highways on which the service is or may be established.

A survey of possible routes east of the Mississippi indicates approximately 7,500 miles of highway to be covered, of which at least 5,000 miles would be essential to successful motor truck service.

Five thousand miles of permanent roads, exclusive of bridges and municipal streets, already completed and not included in contemplated construction, would cost about $20,000 per mile, using every possible economical method of construction, including convict labor where available, prisoners of war, and local road making materials. The entire 7,500 miles would cost about $150,000,000.

One thousand of a possible 5,000 cars, operating east of the Mississippi should earn (based upon statistics obtained where keen competition from available means of conveyance appears) $40,000 each per annum, or a total of $40,000,000 yearly, from which sum should be deducted annually $5,000,000 for cost of operation of cars, $10,000,000 for indirect cost of transportation of mails to and from the routes, and $5,000,000 for extensions and additional service. The remainder, $20,000,000 per annum, could be applied for the construction and maintenance of National Highways.

The Post Office Department does not believe this idea at all impractical. It points out that 10,000 routes earning $40,000 each year would produce $400,000,000 per annum or more than the total annual postal revenues at this time. There are 60,000 rural and star routes in operation in the Postal Service. Therefore, 10,000 motor truck routes is not an unusual number or a startling one. If each route transported but 100 pounds of first-class mail daily the revenues would be $45,000 per year. Of the total of 10,000 possible routes at least 1,000 can be located where the income will certainly not interfere with existing postal revenue and surplus earnings of those 1,000 routes would in due time build and maintain the proposed Federal roads.

How We Are Training Our Specialists in Gas Warfare

INSTRUCTORS in gas defense are to be trained at Camp Humphreys, Va., the new camp of the Engineer Corps. The plans contemplate a course of instruction of about a month's duration, at the end of which the graduates will be fitted to become division gas officers, taking charge of the work of preparing American soldiers for defense against gas attack. About thirty gas officers will be trained at a time. The first of the gas schools has just started its work.

The gas officers who now are on duty with the various divisions received their training at the camp at American University, Washington, D. C. These officers completed their training last November and were at once assigned to duty at the different National Army and National Guard camps in this country. To meet the need rising for additional officers, the school was established at Camp Humphreys.

Most of the gas officers are commissioned first lieutenants. Special qualifications are necessary in order to qualify for this service. Besides having a thorough knowledge of chemistry, gas officers must be able to impart their knowledge to others, and, possess ability to maintain discipline.

Under the tutelage of the gas officers who have been at the various camps for the past six months the troops which are going forward to France are well posted on methods of combating gas attacks. All the men are supplied with gas helmets, but possession of these helmets is only the first step in safeguarding the troops from the gas menace. Under the division gas officers and others assigned by each regiment as assistant instructors, the enlisted men and officers are drilled in the use of masks, taught how to detect the presence of gas and given actual experience with different sorts of gases. Mimic gas shells and cloud attacks, used often at night in connection with high explosives, help to make the training realistic. The enlisted men are given practical training, but company and regimental officers have an opportunity to attend lectures and receive theoretical instructions.

The United States has been able to build on the experience of the British and French, to whom gas attacks were unknown when they entered the war. No Americans have gone to the front without practical experience in defense against gas.

The field training section of the gas defense service was formerly under the Sanitary Corps but now is under the Engineers. A group of British gas officers has been in this country since last summer. One of these men has been at each of the training camps, advising and assisting the division gas officer.

Via Motor Truck

(Concluded from page 124)

trucks. At the Philadelphia garage—a two-story brick building in which are located the main offices of the company—there are adequate inspection and repair facilities. Something like $25,000 worth of parts are always in stock, so that practically any kind of repair can be effected in the minimum time. Here the engines are dismantled and rebuilt, and the trucks are more or less dismantled by a skilled personnel at regular intervals. And that is just as it should be; for like a railroad the success of the organization depends on keeping the rolling stock in the best of condition.

Then there are the "wrecking crews," so to speak, just as in railroad practice. These crews are provided with fast automobiles which carry spare parts and jacks and tools. Skilled mechanics can readily reach any stranded truck within a wide radius of Philadelphia, and bring help to a driver in difficulties. Part of the maintenance service is the inspection station near New Brunswick, N. J., on the Philadelphia-New York route. Here a skilled mechanic inspects the motor trucks as they come thundering up to his shop, and makes such adjustments and minor repairs as may be called for.

In contemplation of the severe winter conditions, the company has lately ordered two powerful emergency trucks provided with gasoline-operated winches and plenty of steel cable, as well as redoubtable snow plows. Even in the middle of winter the inter-city trucks will maintain their rigid time tables; for they will be preceded by the emergency trucks which will clear a way through the deepest snow drifts. The occasional motor truck that may run astray will soon be brought back to the road by the gasoline winches, which are to be among the most powerful ever mounted on a motor truck.

Trucks That Pass in the Night

The whole secret of the success of Mr. Beam's enterprise, to use his own words, "lies in the one word, 'Organization.'" Continues this motor truck specialist: "I have seen at least 200 motor truck companies start and I have seen at least 195 of them fail. They lacked organization and the business ability to put them across.

"The company has, from the first, endeavored to secure the services of only the best men. Our drivers last winter earned an average weekly wage of $45 and there is not a man in our organization who gets less than $25 a week. The draft hit us hard—taking 27 out of 29 men—but we survived even this blow and today we are able to operate our 57 trucks and still have trouble finding room for some of the loads."

By organization Mr. Beam also means service. In fact, service is the very foundation of the motor truck business, and every effort must be exerted to meet the convenience of customers—and still make a profit. It is essentially a business of convenience, after all.

To this end the organization from the first has operated its trucks on an iron-clad schedule, in no case deviating from the fixed routes and the time table. The daily fleet of motor trucks for New York leave Philadelphia at eight o'clock in the evening and reach their destination at four o'clock the next morning. The advantage of night operation is great in more ways than one. In the first place, the roads are comparatively free from traffic at that time; in the second, and most important of all, a shipper can send his goods from one city to the other without losing a business day. The latter advantage is quite marked in the instance of a large retail business which operates stores in New York and Philadelphia. Often special goods of a timely character, which have been advertised in advance, are shipped from one store to the other over night. The goods are kept at one store until just before five o'clock, and then shipped by motor truck to the other where they arrive in time for the earliest shoppers the next day.

From the driver's point of view the night ride presents no great difficulties. Starting out in the middle of the evening, the driver guides his truck through the night. Occasionally a driver will fall asleep, and Mr. Beam likes to tell of one man who awoke in the middle of an orchard at two o'clock in the morning, but his load reached New York only 15 minutes late! But such cases are very rare indeed, and are only such as might be expected wherever that uncertain factor, the human element, is concerned. Reaching his destination at four o'clock, the driver turns his truck over to the receiving department, and goes off to eat and sleep. At the proper time another driver takes the truck to the consignee's door and makes the delivery. In the case of broken loads, that is to say, where the truck contains a number of separate shipments instead of a single shipment, the best procedure is to unload at the receiving station and leave the matter of delivery to small trucks. These same trucks also call for small shipments, which are brought to the receiving station to be loaded on the large mixed-load trucks.

All kinds of goods are transported by Mr. Beam's organization. Indeed, the receiving station on Market Street, Philadelphia, which is typical of the others, presents an interesting study of the scope of the service. On one side are the goods bound for New York, further back are those bound for Baltimore. In another part of the deep store are those bound for Reading, Allentown, Bethlehem and the other points served. A large pile awaits distribution in the city of Philadelphia proper. Everything is orderly and systematic, and an expert shipping man keeps everything moving in due turn. Husky negroes load and unload the various cases and crates and burlapped packages in this veritable beehive. First they remove a pile of rough castings, destined for a shipbuilding yard in the vicinity of Philadelphia. Then there comes a shipment of crated phonographs, bound for Allentown, followed by a bath tub and a bundle of pipes. Then come several crates of eggs, a barrel of flower, and a number of cases of canned goods for some other point. Still the floor is crowded with crated agricultural implements, groceries, plumbing supplies, and so on; for as fast as some goods are removed others are coming in to take their places, equalizing the situation. The range of articles is practically without limit, just as it is in any railroad freight yard. But there is one sign of the times that is apparent on all sides, and that is the marking on the various shipments—"Via motor truck."

The motor truck transport service has made good in these strenuous war times. It has been found reliable, rapid, and without complications. The shipping of goods from the door of the sender to the door of the consignee is a point that cannot be overlooked by shippers especially when the price is within reach of all. Just now Mr. Beam's company is charging a flat price per pound for the New York to Philadelphia and other long-distance hauls, with a correspondingly lower rate for shorter hauls. In the case of light, space-consuming goods, there is a flat space rate per cubic foot for the long-distance hauls, provided the shipments weigh less than 20 pounds per cubic foot, and a lower flat rate for lesser distances. It is the old case of a pound of feathers and a pound of lead: the former requires so much room as compared to the latter, that the pound rate no longer affords a fair means for determining the charge.

From Place to Place Without Stopping

One little point which looms big in the making of a success is the non-stop system of freight service rigidly observed by Mr. Beam's company. In his early experience, like so many others who have tried to build up a motor truck service, he took loads from anywhere to any place. If he got a fair price for carrying the load, he naturally figured he was making a handsome profit. But when the end of the fiscal year came around and he began to work out his profit and loss, he soon reached the conclusion that there must be a serious leak somewhere. Study soon showed him that the leak was the return trip: carrying a load one way is only profitable if there is a return load; and the only way to provide

for a return load is to run the service between definite terminals, irrespective of how tempting may be the requests for other service. Of course, other trucks may be provided for miscellaneous hauling; but nothing must interfere with the regular schedule.

Hence the organization maintains rigidly the routes it has laid down for its service. If a shipper wants to send a load from Philadelphia to Hoboken, which is just across the river from New York, the motor truck makes the regular run to the receiving station at New York. There it is taken over by another driver who brings it over to Hoboken to deliver the goods. And Mr. Beam is quite resolute in his belief that only by operating motor trucks between definite terminals can the system work out satisfactorily.

He knows whereof he speaks, even from recent experience. During several months, and at the request of a Government department, the organization operated a belt line through New Jersey to New York and straight back to Philadelphia, with the idea of serving the farmers in rural sections. Freight was carried out of Philadelphia to the small Jersey towns, and egg shipments were collected for New York. From the last-mentioned point the trucks returned with full shipments to Philadelphia.

The organization carried out its work successfully; but the farmer shippers did not appreciate the service and the company discontinued the belt line. Which again goes to prove that a motor truck service must operate between definite receiving stations; in nowise can it stop at every doorstep along the route, picking up and deliverying shipments. It must be patterned after a railroad, with the single exception that facilities are afforded for collecting and delivering the goods at either end.

Still in his early thirties, Mr. Beam is an energetic man with a great imagination. And he possesses the ability and the experience to realize the products of his imagination. He is a capable executive and organizer, and proof of this is found in the rapid rise of his business, into which he has brought much raw material and which he has converted into a highly-trained personnel. Week after week his motor trucks are mounting in numbers, and the motor truck routes are constantly reaching out in all directions and farther away from Philadelphia.

In the short span of a year and a half, Mr. Beam has organized and developed a company which now ships over 200 tons of freight every day via motor truck—undoubtedly the largest organization in the United States and probably in the world. His service now extends from Washington to the New England States.

Motor Trucks in the War

(*Concluded from page 125*)

that, other things equal, the side having the larger number of machines of this type will have an advantage for aggression in proportion to the numerical superiority on this point. This feature consists in the complete abandonment of wheels in favor of the crawling type of traction and steering. Close observers of the war have long pointed to this as the inevitable upshot of war developments, the doubtful element being only that of manufacture.

The evolution leading to the acceptance of the crawler has been plainly marked. Heavy ordnance was at first transported by the Germans on tractors, to the large wheels of which huge traction blocks were secured. These were far from efficient and gave way to tractors of crawling drive, which got over softer as well as rougher ground, besides travelling faster on fair roads. The principle was more drastically demonstrated in the British tanks. These are designed to resist shocks by brute strength of construction, the foundation back of the endless driving band being unyielding, as against the familiar crawling drive which yields and accommodates itself to the inequalities of the ground. In a rougher but very effective way the tank, when it runs against and tips itself over a large obstruction, brings about this same result of accommodation by means of its rhombic shape.

While this development was going on, in fact even before it had started, the heavy five-ton motor trucks with ordinary wheels were getting stalled with exasperating frequency in plowed fields and even in the roads, often blocking or congesting urgent traffic in both directions. The fault was in most cases with the driving system. The American quads, with all four wheels driven from the engine, did much better and were bought up by the French in as large numbers as available. Their own four-wheel-drive trucks were much heavier and less flexible, and did not do so well; so by degrees lighter and lighter units came into vogue for the front service. Soon all ambulances were the familiar "flivvers" rigged up specially for the purpose, while two-ton and one-ton trucks were accepted as the best war equipment, even to the point of asserting that a hundred of these smaller vehicles would get more men, more ammunition and more food into action in a given time than a hundred trucks of five-ton or three-ton capacity. They could be helped out of holes by man-power much more readily than the bigger units. A disabled unit could be thrown out of a moving column and off the road without delay.

But the small capacity of these trucks was by no means ideal. They were a mixed lot in design and equipment, because the uniformity which had been recognized, even before the war began, as necessary for rapid repairs and replacements, had been realized only in the larger types at that time considered the more important. Their front wheels remained a source of trouble, except in the case of the quads, because they are not driven from the hub, but pushed from the rear wheels, pushed into soft ground, pushed against the far wall of a hole or a ditch, hindering progress and reducing the possible speed instead of helping. Looking forward to a campaign of aggression and rapid advance over a country devastated by the retreating enemy, it was impossible to be satisfied with any type of war truck that did not re-introduce the big unit and guarantee a 10-mile-per-hour speed over any ground cleared by artillery and tanks and with old trenches partly filled up. So military eyes were drawn irresistibly to the demonstrated crawl drive.

Too many persons have witnessed the developments of the past four years to admit of any doubt as to the type of truck, in general, which is most desirable for war work. To what extent Europe's relatively slow but versatile and flexible production system has been turned to the task of manufacturing this type remains to be surmised. This is the one question of paramount and absorbing interest in the war truck situation; it is one, moreover, which profoundly affects all speculation with regard to the effect of the war on the design of commercial motor trucks afterward.

Suppose a five-ton crawl-drive truck weighs 10 tons loaded and is supported on two endless traction belts 10 inches wide and running over pulley wheels, at front and rear, 12 feet apart from center to center. Then the normal supporting area for the vehicle, as well as the area which exerts traction in contact with the ground, is 20 square feet, making the ground pressure 1,000 pounds per square foot. This is considerably less per square inch than that of a walking man shifting his weight from one foot to the other. When the vehicle leans to one side the pressure per square inch is increased; but because of the yielding contours of the driving mechanism it always remains within bounds. To steer, one belt is driven faster than the other; and the practical turning radius is smaller than in wheeled trucks. In meeting a large obstruction the front curve of the belts helps in getting over; and after it is surmounted the spring-mounted idler pulleys take up the belt to conform with the ground contours, so the tractive effort continues to be widely distributed. These are the well known chief characteristics which, with technical details worked out to military satisfaction, seem now to be finally turned to account.

The manner in which the United States is supporting this radical movement of inscrutable possibilities has been set forth in earlier articles in these columns. The organization of American productive facilities for manufacturing war trucks of the several classes, as well as of quads, represents a larger factor of safety for the Allies in this military innovation than any which they could produce themselves or have produced for them by any other means. At the same time, our ordnance officers are openly very busy testing and developing crawl drive tractors for the transportation of artillery; and among the types thus being tried, two or three have sufficient loading space to bring them very close to motor trucks. The United States will scarcely be unprepared for seconding the innovation directly and effectively when this shall be required. It seems within the possibilities that the days of the wheel for all heavy motor vehicles are actually numbered.

Army Truck Trains

(*Concluded from page 132*)

certain space must be maintained between each truck of a group of 10, and a considerably larger space between the three groups of ten or eleven trucks each, comprising the truck train. A passenger car is provided for the officers, and advance scouts and section chiefs are mounted on motorcycles.

It will be apparent that much of the success obtained with proper transportation in the army can be traced to proper organizations and equally good results may be obtained when truck fleets are used for commercial work if they are properly organized and supervised. Much of the trouble and expense met with by firms who have been unsuccessful in using motor vehicles in their business can be attributed to lack of appreciation of the fundamentals of systematic organization and maintenance of the truck fleet. If the government finds it profitable to supply a machine shop truck with each truck train, the industrial truck user should have no hesitancy in making the investment necessary to secure adequate machinery and skilled workmen who keep their trucks in commission.

General Utility Tractor Controlled With Reins

(*Concluded from page 132*)

any vehicle. The main drive-wheels are located in front, are 66 inches in diameter and have a 12-inch face. The small non-drive wheels are 30 inches in diameter and inasmuch as they carry but little load are but six inches face. The engine is a four-cylinder type having cylinders cast in pairs with a bore of 4.25 inches and a stroke of 5.75 inches. It will deliver 25 horse-power at normal engine speed of 900 r.p.m. or 36 horse-power at 1,200 r.p.m. It has a rated drawbar-pull at normal engine speed of 15 horse-power and it can pull three 14-inch plows. Provision is made to use either gasoline or kerosene as fuel. Change-speed gearing is of the sliding spur-gear type and the final drive is by the usual bull-pinion and bull-gear transmission used on tractors of conventional design. A cone clutch faced with asbestos fabric and running in oil is used to deliver the engine power to the change-speed gearing. The gear ratio provided is 70 turns of the engine crankshaft to one turn of the traction wheels on low speed and 44 turns of the engine to one turn of the wheels on high speed. The transmission shafts are mounted on heavy-duty roller bearings. The machine as shown has a total length of 164 inches and overall width of 91 inches, total height of 72 inches and a wheelbase of 97 inches. The weight with 25 gallons of fuel and water and oil ready for the road is about three tons.

The distinctive feature of the entire construction is the manner in which steering is accomplished. This is done by swinging the entire power plant around on the circular supporting track attached to the frame bar or pole by mechanical means which are controlled by the reins. Pulling the right rein will engage mechanism that will make the entire power plant swing around to the right and the axles supporting the driving wheels will be at an angle to the pole or frame member. Similarly a pull on the other rein will cause

the power plant and driving assembly to swing around in another direction. The driving clutch is released by pulling both reins just as would be done in stopping a horse and is engaged by releasing the tension on the reins. When the tractor is used for road hauling purposes the traction lugs are removed from the wheels and sectional or block-type solid rubber tires are bolted to the wheels rims in their place. In addition to providing traction the machine may be used for belt work as a belt pulley 13 inches in diameter and 6½ inches face is directly driven from the engine crankshaft. Two changes of speed are provided, the forward speed being from one to 5.25 miles per hour and a reverse of from one to two miles per hour, depending on engine speed. The feature that makes this tractor suitable for use with any type of horse-drawn vehicle is that the wagon pole may be attached to the rearwardly extending frame bar of the tractor. When this is done the non-drive wheels may be removed as the proper degree of support is obtained by the front wheels of the vehicle to which the tractor is attached.

Navigating Instruments of Our Aerial Pilots

BEFORE an airplane can be put into military service it must be equipped with nine or more delicate aeronautic instruments, some of which are absolutely essential to exact flying, and all of which contribute to the successful operation of a plane. Without them a pilot would lose his location as to height and direction; he would not know his speed through the air, the speed of his propeller, the amount of gasoline in his tank, the temperature of his cooling water, or if his oil was circulating. He could not tell whether he was banking properly on his turns. These comprise the necessary flying instruments. but an aviator could not fly to any great height without another valuable instrument, an oxygen supplying apparatus, nor could he operate his guns, signal headquarters, release his bombs, or "shoot" his cameras without additional mechanisms.

All these instruments must be ready for installation on the airplanes as soon as they are assembled, for no plane is complete without them. In some instances, particularly for the two seaters and the heavy bombing machines, two and even three instruments of each sort are necessary, totaling sometimes as many as 23, but for ordinary work only about nine of them are needed. The average cost of a set of navigation instruments for a single plane is $350.

For operation of actual combat planes, such as observing, photographing, bombing, and fighting planes, many other complicated and expensive instruments and sets of apparatus are necessary. Among them are machine guns, gun mounts, synchronizers, bomb racks, bomb-dropping devices, bomb sights, radio, photographic, and oxygen apparatus, electrically-heated clothing, lights and flares. The cost of such additional accessories would bring the total cost of equipment for a plane to several thousand dollars each, depending upon the type of plane. But these devices will not be discussed in detail here.

The Signal Corps is purchasing practically all the purely navigating instruments and selling them at cost to the manufacturers of the airplanes as they are needed to meet the actual output of planes. This provides one purchasing center and prevents the various airplane companies and the Government from competing against one another, creating disorder and confusion among the instrument manufacturers. At the same time it enables the Signal Corps to keep the supply of instruments adequate for the demands of airplane builders, relieving them from this work, and it also affords standard equipment and interchangeability.

When the American air program began to be developed none of the instruments so vital to the service was being produced in quantities and some of them were not being produced at all. Over 60 per cent of these instruments had to be developed from foreign models, and the remaining 40 per cent was secured by modifying or remodeling American automobile-type instruments. Numerous and serious difficulties were encountered in designing instruments, capable of quantity production, of the lightest possible weight and under exacting requirements as to accuracy. During this pioneer work new instruments were being developed abroad almost daily, each new design carrying an improvement.

Most of the work in this connection was done by the Signal Corps in conjunction with manufacturers. All available information and data were collected, foreign and domestic models and types were carefully tested, designs were standardized, and specifications prepared. Result show that types for every class of instrument have been adopted and put into production here. Far greater standardization has been reached than exists in Europe today, tending to increase quantity production materially and decrease the number of replacement parts necessary.

Quantity production on the scale necessary demanded the enlargement of all existing sources of supply and the creation of many new plants and factories. A certain amount of time was available before it was necessary to use these instruments on planes in service—the planes themselves had to be built. Accordingly, orders were placed from three to eight months ahead of requirements, but only in such quantities as would insure a steady production, owing to the certainty of improvements in the various designs.

The early plans of the production department have developed from two to five sources for each instrument, established both as a safety measure and as a means of placing future orders on a strictly competitive basis.

Various instruments developed by the Signal Corps include:

The *tachometer*, or revolution counter, is an instrument which indicates the number of revolutions per minute at which the engine is running. Unlike the speedometer of an automobile, it does not translate the revolutions into miles per hour; another instrument gives the speed in relation to the air. When instrument matters were taken up last July there were no tachometers manufactured in this country of the type which has proved most successful abroad; namely, the escapement or chromatic type. Two large manufacturing companies are now turning out these instruments in large quantities, one of them 100 a day, and a third company has also in production a new centrifugal type.

The *air speed indicator* is a pressure gage for showing the speed of the plane in relation to the air, not the earth. This instrument includes what is known as a Venturi-Pitot tube, which is fastened to a strut and takes in the air from ahead. The air sets up a corresponding pressure in an auxiliary tube, which is calibrated and indicated on a dashboard recording pressure gage.

The *altimeter* is an aneroid barometer, graduated to read height above the earth, instead of pressure. Under standard specifications a reduction in weight and size was effected in the manufacture of these instruments, which are now being produced in large quantities and of a quality equal to the best foreign make. Three standard types are made, with ranges of 20,000, 25,000, and 30,000 feet. Production was up to 500 a week in April.

The *airplane compass*, after much experimental work, has not reached the perfection desired. A new type, having advantages over any present form of compass, especially as to compactness, is now used. In the development of this instrument effort has been made to reduce the weight to the safest possible minimum and to decrease the space required in the airplance. One concern is now turning out compasses at the rate of 200 a week.

Airplane clocks, thanks to the development which had been made in time pieces for automobiles, were not difficult to secure. It was only necessary to standardize a design of mounting in order to adopt such clocks to airplanes. Sufficient quantities are now available for all needs.

Instrument-board *pressure gages* were

already manufactured here in large quantities, and as soon as standard specifications were developed production started. Two types are used, one to register the air pressure which forces the gasoline to the engine and the other to show the pressure produced in the oiling system by the oil-circulating pump. Standard forms of cases and dials with interchangeable glasses and bezels have been designed.

The *radiator thermometer* is mounted on the instrument board, where it indicates the temperature of the cooling water in the engine. Undue heating shows that the engine is not running properly or that more water is needed. Thermometers of this type made here were, and still are, being submitted to extensive tests. Efforts were also made to stimulate the trade toward developing more accurate and reliable instruments, and now a sufficient supply is available from two sources.

An instrument used to show when a plane is correctly banked in making a turn is the *banking indicator*. Spirit level, balance, and gyroscopic types are being used. The problem of indicating the extent to which a plane is inclined to the horizontal in the air is a very complicated one. No simple solution has yet been reached. Fortunately, it is not often necessary to determine whether the plane is exactly horizontal, except with bomb dropping. Development work is under way which it is hoped will lead to improvement of devices already in use abroad.

The *Aldis sight*, which is used in connection with fixed guns firing through the propeller, has been copied as regards its optical features from an English instrument; but the construction has been modified in such a way that the behavior of the instrument in actual use will probably be very much improved. After a number of tests and experiments satisfactory instruments are now available. The makers have been assisted in recomputing the lenses to suit the optical glass available in this country. The illumination of these sights for night operation is also being studied.

In connection with the design of all these instruments it has been found possible, without delaying production, to standardize them to a much greater extent than has been done abroad. In this way the number of necessary replacement of parts has been reduced to a minimum, and a uniform type of dial has been adopted which, as to legibility, will be equal to the best that has so far been used. All finished instruments are carefully tested before being mounted on the planes.

Among other things, safety belts for pilots, observers, and gunners have been designed and are now in production; radio and photographic apparatus, ordnance devices, and oxygen apparatus have also been developed and put in course of manufacture.

How Germany Utilized England's Tin Plate Scrap

THE extent to which Germany absorbed old tin cans and tin plate from England before the war and some of the processes by which the tin is removable from such material is doubly interesting at present, when we are urged to employ every means possible to save by-products and scrap of all kinds, and when tin itself has reached the highest price in its history.

Before the war a German firm established, in several parts of Great Britain, large works for cleaning tin cans, recovering the tin and solder, and pressing the clean steel into bales. In this way they shipped a large quantity of good steel to Germany. Ultimately they stopped detinning in England and merely desoldered the scrap and shipped it baled to Germany. Detinning by the chlorine process was cheaper on the Continent, yielding, in addition to the sheet, tin tetrachloride, a valuable product of silk manufacture. Tinned steel plate to the amount of some 150,000 tons, some of which is believed to have been detinned, was exported from England for many years before the war, and thus Germany obtained at small cost a large tonnage of steel and other metals that could have been worked up into marketable products.

There are several methods proposed to recover the tin. One depends on the use of acids to dissolve the tin from the steel, but here there is a difficulty in preventing the steel from being dissolved at the same time. Another, in which caustic alkali is the solvent employed, has been used to remove the tin and obtain clean steel. In a third the scrap tin is treated with dry chlorine gas, the product being tin tetrachloride. According to a process suggested by Bergser, an aqueous solution of tin tetrachloride is used as the solvent; the product is then stannous chloride, which can be electrolyzed into metallic tin and chlorine. The latter gas can in turn be recombed with stannous chloride to yield tin tetrachloride with which further quantities of scrap are treated. By electrolysis also the metal can be recovered from the solution formed with the aid of acids or caustic alkalis. Solder can be extracted in a desoldering furnace, provided with means for obtaining a neutral atmosphere to prevent excessive oxidation, and when a clean steel is obtained hydraulic or mechanical presses are used for pressing it into blocks weighing about one hundred pounds.

Making Paper from Dead Leaves

BOTH in Europe and in America there has been a sharp rise in the cost of paper, and this has been peculiarly critical in France. Even before the war France imported half a million tons of paper pulp yearly from Austria and Germany, or about half of the whole amount used. The cutting off of the supplies from the Central Powers, and the severe deforestation due to the war have made paper pulp so scarce and so expensive that many periodicals have been forced to suspend publication. It is now proposed to make use of fallen leaves to supply this lack of raw material. On March 27th, M. Edmond Perrier of the French Academy of Sciences presented before that body an account of the successful experiments along this line of Madam Karen Dramson.

The process is very simple, rapid and inexpensive; the leaves are first crushed, which reduces the blade to powder, which is carefully separated from the ribs and veins. It is the latter which form the raw material for paper pulp. They are subjected to a somewhat rapid lixiviation and are then washed and bleached, whereafter the pulp is ready for use. The leaf powder which remains is useful in two ways. It has a high food value, since it contains the digestible and nutritious parts of the leaf after the removal of the cellulose. As a food for cattle its nutritious value is almost equal to that of hay, especially when mixed with molasses and compressed into cakes. The leaf powder may also be used as a combustible. For this purpose it may be compressed into briquettes, either with or without being previously mixed with charcoal powder.

Madam Bramson recommends however, the practice of dry distillation, by means of which she obtained a comparatively pure porous charcoal rich in calories (6,500 to 7,000 cal.), and easy to agglomerate. The process also yielded an excellent tar, having all the qualities of the so-called Norwegian tar, as well as acetone and pyroligneous acid. One thousand kilograms of the leaves yielded 250 kilograms of pure carbon (or 500 kilograms of edible powder) 30 kilograms of tar, one kilogram of pyroligneous acid and 600 grams of acetone. According to a recent estimate by the Director of the School of Grignon, France produces annually between thirty-five and forty million tons of dead leaves. It is calculated that only four million tons would be required to furnish the paper pulp required in an average year. The economic importance of the question is evident from the fact that in 1913 France paid $20,000,000 for the paper pulp imported from the Central Powers.

It is believed that the collection of the leaves can be done by women, children and war cripples. The leaves can be transported to the paper mills in compressed blocks, but it would be better to build factories on the borders of great forests so as to eliminate the cost of transportation.

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NEW BOOKS, ETC.

RUSSIA'S AGONY. By Robert Wilton. New York: Longmans, Green and Co., 1918. 8vo.; 368 pp.; illustrated. Price, $4.80 net.

Many questions are answered by this solid but eminently readable volume, written by a London *Times* correspondent who has witnessed at first hand Russian events of the past fourteen years. The rise of the New Regime made it possible for this shrewd observer to give for the first time the whole truth concerning Russia as she was and is. Part I deals with Slavdom, the Taters and autocracy, including Razputinism, the Jews, and revolutionary parties, and answers that frequently heard query, "Who are the pro-German party?" Part II covers the Revolution, Bolshevism, and anarchy; Part III, Russia at war, through the Bolshevist betrayal; Part IV, Kornilov and the Cossacks. The closing chapter sets forth the author's conclusions as to Russia's future. The numerous illustrations show the celebrities both of the Old and New Regime, and include a plan of Petrograd and a map of Russia showing the distribution of Cossack armies and their possible communications with allied countries, together with the principal coal and oil fields.

MEN IN WAR. By Andreas Latzko. New York: Boni and Liveright, 1918. 8vo.; 264 pp. Price, $1.50 net.

Have you ever crossed that old wooden, roofed bridge at Lucerne, the one called the Mühlenbrucke, glancing up, as you go, to that series of grotesque paintings representing the Dance of Death? Out of the gloom stand forth groupings of hideous figures, and the bony claws of skeletons seem extended toward the human observer. Six such vignettes, translated into literature, compose the material of this book, "Men in War," written by an Austrian officer. Each conveys the sheer horror of war; there is provided only just enough light to make the darkness and the things of the darkness visible. The literary claims of the work and its perfection of brutal simplicity cannot be denied; but against this Austrian conception we like to place the words of the French poilu: "We sleep in mud, we bathe in blood, but our souls, they dwell among the stars."

THE EARTHQUAKE. By Arthur Train. New York: Charles Scribner's Sons. 1918. 8vo.; 307 pp. Price, $1.50 net.

John Stanton, a typical American man of affairs, "running to seed spiritually and intellectually," returns from the Orient to his own New York, and finds himself in a new world. The reactions of war conditions and emotions upon him and his family is representative of the upheaval that is affecting so many American families today. It is a dramatic study of the break-up of social and class distinctions under the threat of a common danger. It makes quite clear to the reader that this is our war, that sacrifice is our duty and privilege; it is a clarion call to the individual to rise to arduous action, as well as to wave flags to the music of the band; and, being a rousing story by a well known writer, it will probably reach a wider audience and exert more influence than the same material cast in a non-fictional mold.

THE STOCKOWNER'S GUIDE. Sydney, Australia and London, England: The Pastoral Review Proprietary Limited. 8vo. 286 pp.; illustrated.

All farmers are naturally interested in such subjects as economical and efficient fencing, water supply and irrigation, and ensilage, while the stock raiser is always open to pointers on dipping—which, in addition to eliminating insect pests, cleanses the skin and improves the growth of wool—and on remedies in general for the diseases of sheep, cattle and horses. The work in hand is a collection of little articles from Australia's excellent farming and live stock journal, *The Pastoral Review*, arranged for the most part under definite headings such as indicated above, and conveniently indexed. Stockowners the world over have contributed from their practical experience, and our own agriculturists will find successful devices carefully described, modern methods set forth in detail, and recipes of the best remedies known to the breeder and veterinary.

HANDBOOK FOR RANGERS AND WOODSMEN. By Jay L. B. Taylor, Forest Ranger, U. S. Forest Service. New York: John Wiley & Sons, Inc., 1917. 16mo.; 420 pp.; illustrated. Price, $2.50.

Men inexperienced in woods work will find here simple statements of the problems that confront the forest ranger, with their solutions—not necessarily, as the author points out, the only solutions; individual ingenuity will always be called for, and will always receive its reward. The work is very concise, and sparing of technical terms; it is helpful and accurate, and, although not official in any sense, the Secretary of Agriculture approves its publication and has caused certain revisions to be made in the text. The material will benefit all whose work or recreation takes them into the wilder regions of nature, as well as the ranger in Government, State, or private employ, for whom the manual is especially intended.

TACTICS AND TECHNIQUE OF RIVER CROSSINGS. By Mertens, Colonel and Chief of Section in the Engineer Committee, German Army. Translated by Walter Krueger, Major and Assistant Chief of Staff 84th Division, National Army. New York: D. Van Nostrand Company, 1918. 8vo.; 263 pp.; 105 illustrations, 4 maps. Price, $2.50 net.

Our officers will find in this translation from the German much valuable material on a subject vitally connected with success in military operations. The general discussion takes up bridge construction outside the effective hostile zone, accelerated crossings in presence of the enemy, and forced and surprise crossings, while defense against the hostile crossing is developed in detail. Specific situations and operations, such as the attempt of the 2d Corps at Hirschhorn, the crossings of the Neckar and Rhine, and the defense of the lower Oder, are carefully analyzed, and appendices deal with expedients for quick crossings, with bridge trains of Germany, England, France, Italy, Austro-Hungary and Russia and their capacity, and with the time required to build improvised bridges.

ABOVE THE FRENCH LINES. Letters of Stuart Walcott, American Aviator: July 4th, 1917, to December 8th, 1917. Princeton: Princeton University Press, 1918. 8vo.; 100 pp.; illustrated. Price, $1 net.

A profound conviction of duty led Stuart Walcott, a Princeton senior, to throw in his lot with the Allies. These letters vividly portray his training experience at Avord, with his progress from the "roller" to the "unbustable" Spad. After a period of impatient waiting,—"they take," he says, "lots of care of new pilots and don't feed them to the Boche right away"—he is given patrol work. On December 12th, in pursuance of this duty, he met with and shot down an enemy biplane carrying two men; on his way back, he was overtaken by four Albatros planes, outfought, and sent down in a nose dive within the German lines. Walcott came of a fighting ancestry and nobly upheld the traditions of his race. His letters show, as Major General Squier says, "the magnificent spirit of our airmen."

THE PSYCHOLOGY OF WAR. By John T. MacCurdy, M.D. Boston: John W. Luce and Company. 12mo.; 95 pp.

War is no longer a mere matter of fighting, but engages every element of national thought and activity—engineering, chemistry, bacteriology, agriculture, even domestic economy. But it is hatched in the mind of man, and only through the youngest of our sciences can it finally come to be understood. This thoughtful essay examines the theories of Freud and James, presents a rather sustained analogy between war and mental disease, and seeks to correlate primitive and gregarious instincts with some approximation to balance and sanity. It is a surgeon using the pen as he uses his scalpel; the result is some new aspects that are well worth our earnest consideration.

AMERICAN CARICATURES PERTAINING TO THE CIVIL WAR. Reproduced from the Original Lithographs. With Introduction. New York: Brentano's, 1918. 4to.

James Gillray of England may be called the father of caricature; he had a gross hand, quite Teutonic in its weight; his work ended nearly fifty years before the initial date of the caricatures presented in this collection and, while these still exhibit a crudity of thought and method, they are pointed, sincere and intelligible, and make up a folio of considerable historic interest. They begin with Maurer's cartoons on the Fillmore campaign, run through the campaign of Buchanan and Douglas and the Jackson election, and then yield the stage to Lincoln and the Abolition movement. The War of the Secession and its aftermath of rancorous relations are handled with a vitality that makes the hot blood of the past run again, and the collection will prove an acquisition for the library table.

THE WAY OUT OF WAR. Notes on the Biology of the Subject. By Robert T. Morris, F.A.C.S. Garden City, N. Y.: Doubleday, Page and Company, 1918. 12mo.; 166 pp. Price, $1 net.

The jurist of tomorrow will be called upon to draw up peace terms and draft laws governing international relations; to be efficient and enduring, his findings must be based upon natural law as set forth in Darwin's principle of interdependence. The author conversationally gives us his own views of the situation and the way out, backing his arguments by concrete instances, making original interpretations of facts, and taking as his data for action not that of the diplomat looking backward to past history, but that of the naturalist looking forward to a continuation of the progress evidenced in the evolution and perfection of plant life.

THE SCIENCE AND PRACTICE OF PHOTOGRAPHY. By John R. Roebuck, Ph.D. New York and London: D. Appleton and Company, 1918. 8vo.; 312 pp.; illustrated. Price, $2 net.

The word "photography" calls up to the average student attractive visions; the word "science" as associated with the curriculum conjures up misty abstractions. Since the predisposition of the student is, generally speaking, toward photography and against quantitative chemistry and the theory of electricity, why not make photography the initial study? Dr. Roebuck has prepared a text with this object in view, and vouches for the success of the experiment in the case of his his own students at the University of Wisconsin. He finds, for example, that the quantitative study of the dry plate is anything but a dry morsel to the student, and induces him "to chew with some relish the tough grist of close thinking." The whole general theory of the art is logically set forth in the first part of the work; the second part is a laboratory manual.

GLORIOUS EXPLOITS OF THE AIR. By Edgar Middleton, Late Flight Sub-Lieut. R.N. New York and London: D. Appleton and Company, 1918. 8vo.; 256 pp.; illustrated. Price, $1.35 net.

If the mechanization of warfare has robbed it of most of the old romance, there is some compensation in the fact that one of the most perfect machines ever devised has given modern tactics a

new arm that permits incredible speed, magical maneuvering, and spectacular heroism. "Glorious Exploits of the Air" is an epic of the aeroplane. "Youth will be served" might be the text; how youth is serving is the theme. We see the public school boy, the undergraduate, the clerk, at their desks; four months later they are high above the enemy's lines, engaging German aces, and performing aerial acrobatics to win vantage of their opponent or to save their own lives and planes. The reader is whisked along with these young heroes to take photographs in the midst of bursting shrapnel; he goes with those clumsier night-birds, the bomb-raiders; he fights with Zeppelins, crosses the Alps, and accompanies the air squadrons in a "big push." The author has a seemingly inexhaustible fund of thrilling stories that reveal the human—perhaps we should say the superhuman—aspect of the British air service.

OUR ARMY IN A NUTSHELL. The Civilian's Military Handbook. By George Nestler Tricoche. New York: George U. Harvey Publishing Co., 1918. 16mo.; 107 pp.; illustrated. Price, 60 cents.

A nutshell presentation, for the benefit of the military-minded civilian, of elementary statistics and other information about our Army, including all the publishable important changes in organization since August, 1917. There is a bit of Army history, a discussion of the different units, tactical organization, territorial areas, schools and arsenals, a chapter on ranks and insignia, another on armament and gunnery, and a wealth of miscellany beside.

THE DESTINIES OF THE STARS. By Svante Arrhenius, Ph.D., President, Nobel Institute, Stockholm. Authorized translation from the Swedish by J. E. Fries, Fellow A. I. E. E. New York and London: G. P. Putnam's Sons, 1918. 8vo.; 273 pp.; illustrated, with maps. Price, $1.50 net.

English-speaking students of science may congratulate themselves on the opportunity afforded them by this well-rendered translation from the great Swedish chemist, astronomer and philosopher. Although we have waited three years for this translation, we are compensated by the fact that it is extended to include astronomical discoveries down to 1917. It opens new vistas to the reader, particularly through planetary observations and a study of the relation of the stars to the Milky Way, and our surmises as to "the changing fate and future position of the earth" are placed on surer foundations. The introductory chapter on the origin of star worship abounds in both occult and historical interest and impresses upon us the distance science has traveled since the days of alchemy and astrology. Chapters on the climatic importance of water vapor and the atmosphere and physics of the stellar bodies lead naturally to a discussion of the chemistry of the atmosphere and the possible presence of life on other worlds than our own, and this theme is further developed in a lengthy chapter on Mars, a masterly review of observations and opinions. The sensationalist may not be over-pleased to reach the author's conclusion that we must "consider Mars as unfit to harbor living beings," but he may find comfort in the expressed belief that Venus may become "the dwelling place of the highest beings in our solar system." The work is richly illustrated, and has folding maps of Mars in Mercator's projection.

AMERICA AT WAR. A Handbook of Patriotic Education References. Edited by Albert Bushnell Hart for the Committee on Patriotism Through Education of the National Security League. With Preface by James M. Beck. New York: George H. Doran Company. 8vo.; 425 pp. Price, $1.50 net.

When we hold that no conflict that was not vindicated by our sense of justice could weld our people together and coördinate all their powers, we do but mere justice to American character. Without the ideal behind the ammunition, the human and humane incentive to rescue civilization from the nightmare that is robbing it of breath, our efforts must fail. The references of this handbook are like the turns of a spade that reveal at each motion the black roots of the world disaster. Speakers, writers and thinkers who are laboring to make known the true story of this long-schemed, vicious attack upon the world will find in this carefully-arranged material arguments overwhelming in their truth and scope; the lukewarm, whether from ignorance of the crisis that is upon us or from inability to visualize its meaning in the sunny life of an uninvaded land far removed from the actual horrors of conflict, should be awakened to the realities and to a sense of duty.

THE AUTOMOBILE REPAIRMAN'S HELPER. By S. T. Williams. New York: U. P. C. Book Company, Inc., 1918 12mo.; 440 pp.; illustrated.

This handy pocket book reprints the best articles that have appeared in the Better Mechanics department of *Motor World*. It concisely presents better methods in the care, repair and maintenance of the car. The saving of time, the efficient sequence of operations, and a successful conclusion, are aimed at in the case of each particular job. Twenty-one chapters each deal with a leading make of car, taking the mechanic through the necessary adjustments and overhauling in a careful and thorough manner.

THE AZTEC HUNTERS. By Francis Rolt-Wheeler. Boston: Lee and Shepard Co., 1918. 8vo.; 363 pp.; illustrated. Price, $1.35 net.

It is a pleasure to find conscientious, accurate work and permanent value in a juvenile story. "The Aztec Hunters" is a worthy successor to former volumes of the Museum Series, and the fact that every detail is authentic detracts not at all from the adventure and mystery of the tale, which deals with a mighty civilization that flourished on this continent a thousand years before Columbus. The attractive full-page plates are from photographs loaned by prominent museums and explorers; the whole will come to the boy reader as a revelation that "the Western Hemisphere is not a New World, but one with heritage and traditions as noble as those of Europe."

GERMAN ATROCITIES. By Newell Dwight Hillis. New York and London: Fleming H. Revell Company, 1918. 12mo.; 176 pp.; illustrated. Price, $1 net.

A number of works have appeared that deal at length with what we have come to term "German atrocities"—the wanton destruction of sacred edifices, the plundering and burning of homes, the murders and mutilations, the debauching of womanhood and the skewering of babes on the bayonet. All these things Dr. Hillis recounts, with proofs taken from the written admissions of the criminals, but the chief value of his book lies in its exposition of the nature and causes of these crimes, the philosophy of them, in short, and of the campaign of education instituted by the Kaiser and his fellow-conspirators, that resulted in perverting the German intellectuals, the merchant class, and finally the people themselves.

RAEMAEKERS' CARTOON HISTORY OF THE WAR. Vol. I. The First Twelve Months. Compiled by J. Murray Allison. New York: The Century Co., 1918. 4to.; 224 pp. Price, $1.50.

This first volume of a series of four from the hand of this war-discovered genius gives us a pictorial record from the first murder at Herve to the real awakening of John Bull. Most of the drawings deal with Belgium, and reflect the Hun-inflicted miseries of that unhappy people. Each cartoon is faced by a page of text; but it must be remembered the pictures were made, for the most part, long before the citations here given from official reports, and some are truly prophetic; an example is the depiction of Count von Bernstorff's dismissal from Washington, published two years before he was handed his passports. Looking over these grim, forceful drawings, we are reminded of that exclamation of Raemaekers at the Savage Club when, indicating the portraits of explorers that line the walls, he cried, "I, too, have been an explorer, gentlemen. I have explored a hell, and it was terror unspeakable."

FACE TO FACE WITH KAISERISM. By James W. Gerard, Former United States Ambassador to the German Imperial Court. New York: George H. Doran Company, 1918. 8vo.; 389 pp. Price, $2 net.

Germany invaded the United States. That is the message which our former ambassador drives home to us in this continuation of the narrative begun in "My Four Years in Germany." He sat face to face with the imperial web-spinner; he learned how that web of intrigue and diabolism stretched into the uttermost corners of the earth; and he heard from the Kaiser's own lips that brutal warning: "America had better look out after this war. I shall stand no nonsense from her." These dramatic episodes and revelations are added to and developed in the later work, carrying on events to the time of the author's return home, with some shrewd observations on the situation here; and the corollary to his demonstrated proposition of the Teutonic invasion of the United States is this: "That the sanctity of American freedom and of the American home depend upon what we do NOW." Nor is the vision of the author confined to the mere defeat of the war monster. He realizes that we are on the threshold of far-reaching adjustments of the social structure, and believes that the single-hearted patriotism that will emerge from our melting-pot will set itself to healing the wounds of civilization in an enlightened and truly helpful way.

THE BIG FIGHT. (Gallipoli to the Somme.) By Capt. David Fallon, M. C. New York: W. J. Watt and Company, 1918. 8vo.; 136 pp.; illustrated. Price, $1.50 net.

The dramatic experiences of Captain Fallon began in fights with the pestiferous hilimen of India; he went through the ill-fated Gallipoli campaign, was in numerous fierce trench conflicts, commanded a tank, served as aerial observer, and lay for three days in a shellhole desperately wounded. His simple account of these adventures, and of many others worthy to rank with them, give us a series of sharp pictures that make the great war very real, and leave us with an admiration for the cool bravery of the men who are facing incredible things for an ideal. There are a half dozen striking illustrations of military activities and a portrait of the author.

USE YOUR GOVERNMENT. What Your Government Does for You. By Alissa Franc. New York: E. P. Dutton and Company, 1918. 8vo.; 390 pp.; illustrated. Price, $2 net.

The Government reaches and helps a vast portion of our population; it should reach and help many more; that it does not is due either to our ignorance or indifference. Whether you farm it, or carry on a business, or run a home, or are still in school, the hand of the Government is extended to your aid. There is another side to this; it needs your help, especially in the present crisis. Alissa Franc tells you all about it, how to make direct personal use of our Government, and how it and the people may coöperate to the benefit of both. The chapters classify the individual according to occupation or standing—the working man, the negro, the immigrant, the farmer, down to the girls and boys. It is a timely work, full of vital information, and it is to be hoped that it may be widely read.

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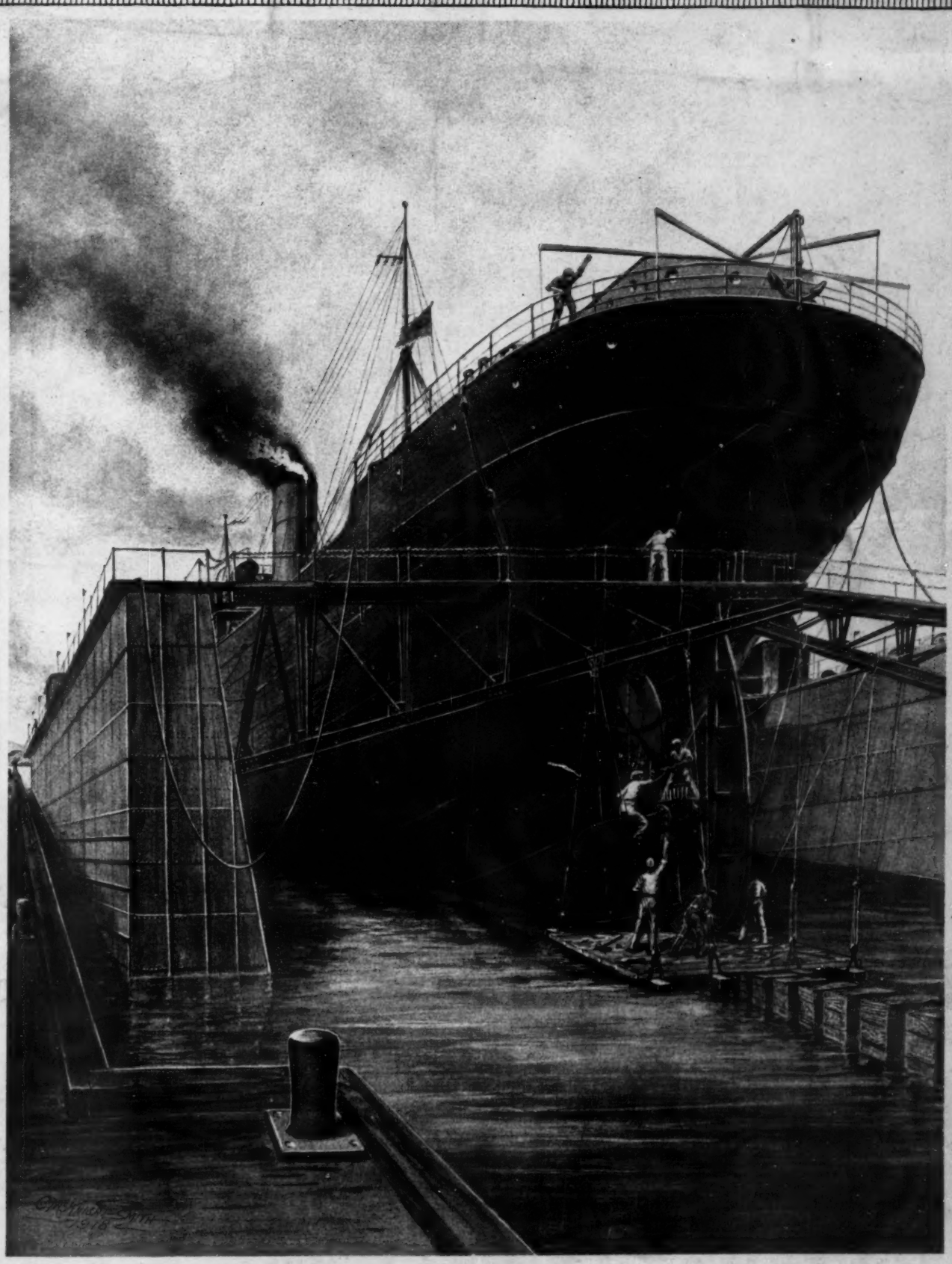

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August 24, 1918

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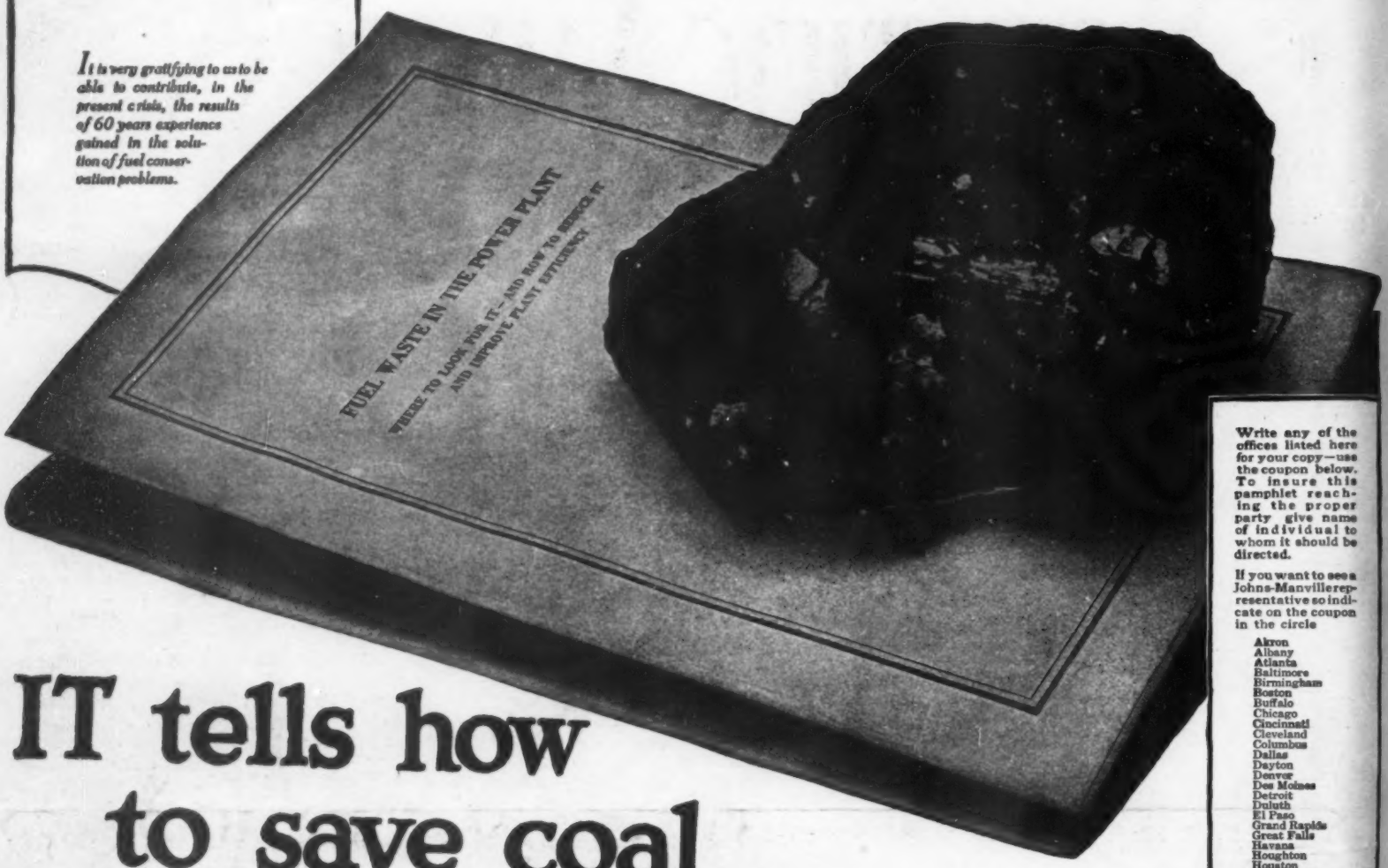

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